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Electricity Applied to Coal Mining

By J. T. Jennings *

THE Electrical application to coal-mining machinery is not new. It has been employed in a limited way for nearly 25 years, principally for haulage work, and it is only recently that its value and possibilities are being fully realized by coal-mining companies.

During the period when shallow beds were being mined, low first cost of equipment furnished by steam boilers, engines, and cheap fuel with plenty of good labor, outweighed any economic consideration of the wasteful practices employed.

The growing demand for scientific efficiency and conservation, the increasing difficulties of underground development caused by deeper mines, the longer hauls demanding larger equipments, the increased cost of lower grades of fuel, and a growing scarcity of good labor, are some of the causes which are prompting the mining companies to a higher standard of economics.

We recommend that every man interested in any phase of coal mining read this article written specially for us by one who stands at the head of the younger generation of electrical engineers. Coal Age has never published a greater amount of valuable information in such few words, as appears on this page and the one that follows. Mr. Jennings' forecast is definite and his ideas clean cut. No doubt or question is left in the mind of the reader.—Editor.

Electricity is gaining favor because it offers greater possibilities in economy, for generating and transmitting from one source, a simple and flexible power for all classes of work.

Generation.—The increasing demand for electric power at remote distances from the power plant is revolutionizing the system of generation and distribution. The simple direct-current plant, good only for short distance work, is giving way to the alternating-current system which is more suitable for transmitting power long distances. Power-house units are continually increasing in size and the general tendency is toward central station practice. The future modern power-station units will consist of high-pressure steam turbines, condensing or non-condensing, depending on the local water supply. The steam turbine by its simplicity, reliability, high efficiency, low first cost, minimum foundations, restricted building-space requirements and low maintenance cost will supersede the steam engine entirely.

There is no question but that the colliery electric-power supply in the future is going to be concentrated for all uses in a given territory in one system. A single power plant constructed to give economic generation of power, substitutes for the steam and air systems an economical flexible arrangement of distributing lines, capable of giving any desired voltage for long distance transmission. Such a system can be spread over an area covering one or several collieries using rotary converters or motor-generator sets for supplying continuous current of any voltage for haulages and special installations. This plan will also afford alternating current of any voltage for stationary motor work.

Haulage.—Electric locomotives are rapidly superseding all other systems of transportation in mining. They have fully demonstrated their superiority in efficiency, low cost of maintenance and dependability. The latest improved type of Locomotive is constructed on open lines, having cast-steel bar open frames, giving accessibility to brake rigging and other internal parts. In this machine, the electrical equipment consists of interpole motors spring-suspended throughout, of ample capacity to withstand without damage the heavy overloads imposed upon them. Commutator troubles are also reduced to a minimum.

Recent improvements in storage batteries will doubtless prove an advancement in the art of mine haulage in the near future if the claims of storage-battery manufacturers can be substantiated. Especially will this be true for the service of gathering, as the maintenance cost of any gathering locomotive is excessively high under the present method.

*Chief electrical engineer, Philadelphia & Reading Coal & Iron Co., Pottsville, Penn.

Hoisting.—Electrically operated hoists have made rapid advancement during recent years. An electric motor possessing rotary motion uniformly applied throughout the entire cycle, high torque characteristics, the power requirements, and losses limited to its operating time, is an ideal method for hoisting conditions compared with the use of steam or air.

With the recent introduction of alternating current systems, we find the induction type of motor most generally used. The absence of commutators with their inherent troubles favors the induction motor whenever possible.

At present electric hoisting has been confined almost entirely to slope work ranging in powers up to 250 h.p.; however, indications point to a broadening of the application to larger equipments.

Pumping.—Anthracite mines as a rule are arranged to drain all water to one large pump which comprises the main pumping plant. At this point large quantities of water are handled by compound-condensing steam pumps supplied by steam lines through bore holes generally located adjacent to boiler houses. The steam operation compares favorably with electric pumping.

Electrically operated pumps are mostly confined to remote places, the capacities ranging from the small sinking pump to large machines of 1000 gal. working against a 400-ft. head. Some companies have gotten fair results with motor-driven centrifugal pumps; however, owing to the acidulous nature of most mine waters, motor-driven triplex cement-lined plunger pumps have proved most satisfactory. For fresh-water pumping stations on the surface, the motor-driven centrifugal pump is extensively used and rules supreme.

Until centrifugal pump manufacturers can produce a reliable pump that will resist the action of most mine waters, we cannot look for any great developments in the field of heavy pumping.

Fans.—The mine ventilating fan is one of the most important machines around any coal mine, as the lives and efficiency of the miners depend on continuous air circulation. The general practice of driving fans has been by steam engines, because experience has proved their reliability and ease of control.

In recent years a number of fan equipments have been changed from steam to electric drive, and are giving reliable service with good speed control, and costing less to operate. For operating fans, the shunt wound interpole continuous motor with field control or the alternating-current induction type variable-speed motors are mostly used connected by chain or belt drives, although in some cases the motors are connected direct to the fan shaft. There seems to be a tendency to go to synchronous motor-driven fans, thus receiving the benefits derived from synchronous motors on the system; however, the importance of reliability should not be overlooked in adding complications. As the electric motor proves its reliability and wins the confidence of mining men, there will be greater activity in this line.

Breakers.—Anthracite coal breakers by virtue of their complex system of operation involve considerable losses through cost of upkeep from rope or belt drives when operated from one driving source. With an endeavor to minimize these losses and place the breaker drive on a more efficient basis, some of the companies operating dry breakers have substituted individual motor drives on each auxiliary machine. The continuous-current motor was first tried with only partial success, later installations adopting the induction motor have proved more satisfactory. The old method of preparing coal in a breaker divides the machinery into various group drives, necessitating starting, stopping, and running the series of machines in one group simultaneously. The interruption of any one machine stops the entire group.

The disadvantage of the unit motor drive lies in the various sizes required, thus reducing the possibility of duplication without sacrificing efficiency. There is also a resultant poor power factor, and an accident to one of a chain of motors affects the entire group. Furthermore the combined efficiency of a series of small motors is lower than one larger motor when located convenient to the driven machines. For this reason the future electrically-driven breakers will doubtless consist of fewer, larger, more reliable, duplicate motors located conveniently on the various floors for group drive, this will also simplify and lessen the cost of the network of wiring and its upkeep.

The wiring for breaker work is installed either in conduit or open mill construction depending on the conditions to be met.

Various other surface auxiliary machinery is benefiting from the adoption of the electric drive. Motor driven conveyor lines, breaker tipples, ash tramways, washeries, compressors, storage yards, slush dredgers, mining machinery, rock drills, and shops are examples showing the wide adaptability of the electric drive. Due to the greater flexibility of alternating current for the varied service required around a mining plant, and the advantages the induction motor possesses over the continuous-current motor, the future will see the general adoption of the alternating-current system.

Telephones.—Mine telephone installations have grown from a few unimportant local phones to systems of great proportions, having connected loads of 1000 telephones arranged for direct communication. The various operations and offices of coal companies are generally located great distances apart, and the telephone has become an important factor in the daily routine business of the concern. In no other way can a manager have complete control over scattered operations.

The common practice to-day is to establish a central switchboard exchange at the main office of the coal company, from which spread out numerous trunk lines terminating in local exchanges at the various division offices. A division comprises several collieries and each colliery has its own private line to the division exchange. The local colliery system is subdivided to prevent overloading, and the underground lines are normally separated from those on the surface, but arranged by switching devices to connect all together when required.

The iron-clad phone has become standard for underground use, and the wooden-type phone for surface use. Bare copper wire is used for trunk lines, and insulated copper-clad wire for local connections. Armored cables are standard for shaft and slope work where they are subject to mechanical injury, and circular loom-covered cables are generally used for underground lines.

The latest important advance in the mining art is the development of the electric cap and hand lamp for underground workers. For a number of years such lamps did not come out of the development state, due in part to the indifference and lack of proper co-operation by manufacturers producing a reliable equipment that would survive the severe requirements incident to mining. There is now a number of lamps which give promise of great improvement.

Selling Energy Instead of Slack

The use of all, or only the inferior parts of the coal mined, for generating energy to be utilized in neighboring factories, has often been discussed and is now being accomplished in a small degree on this continent. This article describes a small plant in Canada, where for over five years electric energy has been generated and sold in nearby towns.

Note—Extract from the "Electrical World," Sept. 28, Vol. 60, pp. 655-658.

The casual reading of a magazine article a few years ago, by H. J. Logan, formerly member of the Canadian Parliament from Cumberland County, Nova Scotia, was the initial step in the establishment of the pioneer electric transmission plant of the Maritime Coal, Railway & Power Co., Ltd., of Amherst, N. S., at the mouth of the celebrated Chignecto mine, located eight miles southeast of the latter city and within an easy transmission distance from an important industrial and coal-bearing area.

Quietly Operating Since 1907

The article in question suggested the possibilities of electrical transmission from the pit mouth, crediting the scheme to Thomas A. Edison. In company with Senator Mitchell, of Nova Scotia, Mr. Logan visited Mr. Edison at his New Jersey home, discussed plans for the development of the enterprise, and on July 31, 1907, service was begun to the accompaniment of a telegram of congratulation from the great inventor and in the presence of many distinguished guests.

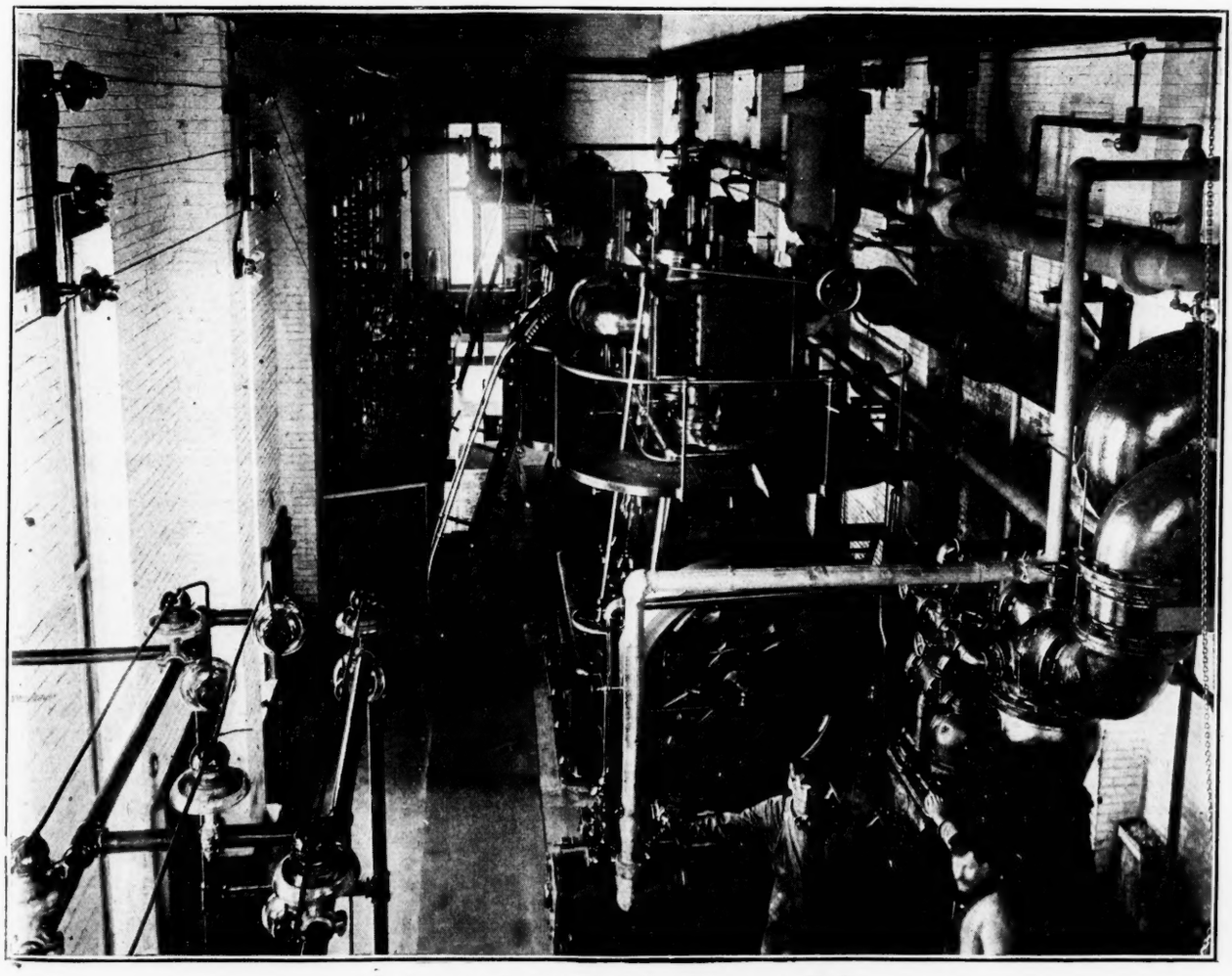
The plant has now been in service for over five years and its success has completely demonstrated the practicability of turning the potential energy of slack or refuse screenings into electricity for sale in distant markets. The demand for its output has constantly increased, and today the installation is the source of electrical supply for the municipalities of Amherst, Maccan, Nappan, River Hebert, Joggins and Chignecto, operating about 60 motors with a combined rating of 900 hp., and a lighting load of about 10,000 16-cp. equivalents in the above communities.

Energy Derived from Unmerchantable Slack

Factory machinery, a gypsum quarry, pumps, blowers, hoists, fans and other equipment are included in the motor load, and by the use of an otherwise unmarketable fuel which constitutes about 30 per cent. of the mine output the plant is enabled to deliver electrically at economical prices throughout the entire district.

The mining area owned by the company in the district covers about 5 square miles, and the output of the mines at Chignecto and Joggins is now about 800 tons per day, with the prospect of an early increase to 1200 tons.

Both domestic coal and steam coal are mined, and the market exists chiefly in Nova Scotia and New Brunswick, although a considerable amount of the Joggins slack is sold in the United States.



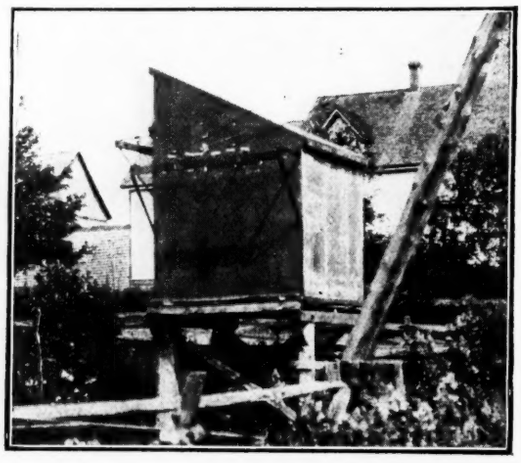
Interior of Generating Room, Chignecto, N. S.

It is estimated that about 12,000,000 tons remain unmined on the property.

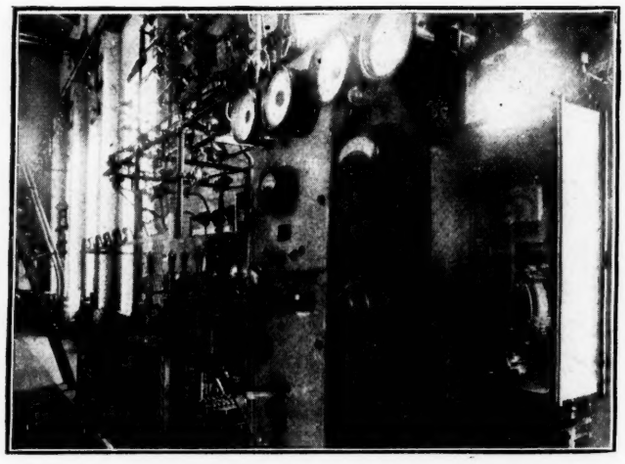
At the time that the company began to mine the Chignecto seam it was found that the top bed was divided from the bench by a soft ply from 6 in. to 8 in. thick. In the mining process this came out in the form of dust or culm and was extremely dirty.

During the screening this material became mixed with the slack, lowering the quality of the latter to such an extent that the slack was of little marketable value on account of the large amount of ash present. It cost the company about 10c. per ton to dispose of the material, so that the saving in converting the fuel energy of this cheap grade of coal into electricity is much greater than if a good quality were used, as the rate per ton for conveyance to the boiler room is the same in both cases.

The fuel used at the plant could not be sold on account of its quality, and the space for banking was limited to an area close to the mine. The Joggins culm is cleaner in character than that at Chignecto, and some of this is marketed, but experience at the plant indicates the desirability of utilizing all the culm from this mine as soon as the load warrants it.



LOCAL TRANSFORMER HOUSE



SWITCHBOARD AT CHIGNECTO PLANT

A SUITABLE BUT NOT EXTRAVAGANT PLANT

The power house is a 75-ft. by 100-ft. brick and steel structure with concrete foundations and is located within about 100 ft. of the colliery bankhead, fuel being delivered to the station from screens at the bankhead by a Jeffery motor-driven conveyor, which discharges into a steel-lined overhead wooden bunker of 250 tons capacity above the firing aisle of the boiler room.

From the bunker the coal is fed to the boiler batteries through inclined swinging chutes discharging into the hoppers of Jones underfeed stokers. The boilers are installed on one side of a single firing aisle with a dividing wall at their rear, the engine room being located on the opposite side of the latter.

Eight 150-hp. Robb horizontal return-tubular boilers are in service, four batteries being installed. Two sets of blower engines and fans are provided, either being capable of giving 5 in. of draft in the ash pit with all boilers in operation.

Natural draft is also provided by a steel stack 60 in. in diameter and 40 ft. high, with a lower section of brick designed to receive the products of combustion from a breeching which leads outward from the boiler room. The stokers are capable of supplying fuel to boilers of 250-hp. individual rating.

Ashes are disposed of by a car running on a track in front of the furnaces, the car discharging into freight cars of the Intercolonial Ry. The ash track is brought out of the boiler room on the south side of the station and is immediately swung around 90 deg. and stubended across two steel I-beams which span the railway track below.

Coal enters the power house on the same side through a gallery, housing the conveyor above mentioned. The fuel burned averages 20 per cent. ash, and when using this culm and refuse the fires have to be cleaned every two hours.

The grate areas of the boilers were designed for 49 sq.ft. each, somewhat above the usual practice, on account of the poor quality of the fuel. The boiler room is provided with an ample supply of daylight, as the firing aisle borders on six large windows.

CONDENSING WATER PROVIDED FROM A POND

Feed and condensing water for the plant is obtained from an artificial pond about 1000 ft. above the power house, the pond being 1000 ft. long, 600 ft. wide and 10 ft. in average depth and held in position by an earth dam which crosses a narrow gulley at the foot of the lake.

The surface of the water in the dam is at the same level as the top of the basement beneath the boiler room. The water is brought to the station in a cast-iron pipe discharging into concrete wells in the basement, and the feed and injection water supplies are taken from these wells.

Ordinarily the feed water is taken from the condenser discharge pipes and is delivered to the front of the boilers after passing through a 1000-hp. Cochrane open heater and an installation of two Canada Foundry Co. feed pumps. A 2-in. Penberthy injector is in service during emergencies.

About a mile above the power house, a second dam of wooden construction, 125 ft. long and 20 ft. high, has been built on St. George's Creek, and it is estimated that about 2,000,000 gal. of water is held back by this. The total supply of water available for feed and condensation purposes is 6,000,000 gallons.

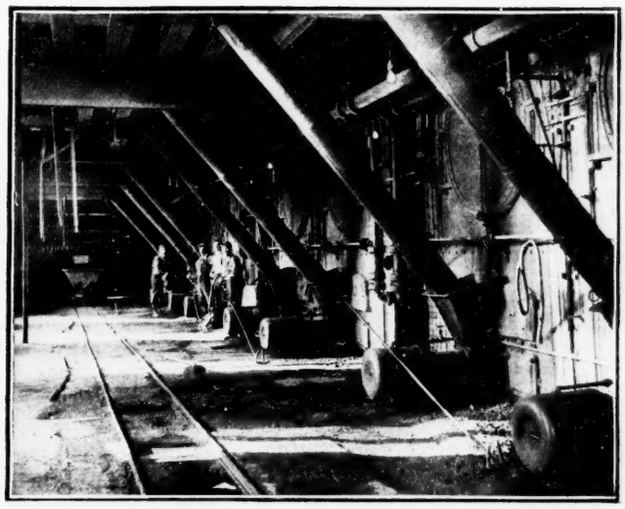
At the upper dam a small pump house has been built, with a turbine pump, motor and transformer installation arranged to supply water to the intake wells as specially required. The motor is operated by an 11,000-volt service from the generating station, control being through a switch in the plant.

Steam is supplied to the bankhead from the boiler room for pumping and hoisting service, the installation shutting down an old boiler plant and saving the wages of two firemen, a machinist and a helper.

The steam and feed-water piping and fittings are of extra-heavy design, all joints being packed with corrugated copper gaskets. Each boiler is connected with an 8-in. steam main at the rear of the boiler room through a 6-in. riser. From the main, leads 7 in. in diameter are run to the engines. The working steam pressure is 150 pounds.

Two 500-kw., three-phase generators are at present in service, each being direct driven by a 17-in. by 33-in. by 16-in. Robb-Armstrong vertical, center-crank, cross-compound engine operating at 300 r.p.m., on a 26-in. vacuum, and having 13-

HOME-MADE COOLING TOWER



BOILER ROOM AT THE CHIGNECTO PLANT

kw. and 20-kw. outboard-hung direct-connected exciters.

These engines are among the largest vertical-type machines ever built in Canada, and are designed for automatic governing within 3 per cent. maximum on momentary changes of load. Each engine exhausts through a 14-in. pipe into a 14-in. by 20-in. by 24-in. twin horizontal jet condenser and air pump of Canada Foundry Co.'s design, the condensing units being located on the engine-room floor beside the engines.

The engine bearings are fitted for water cooling, and each unit is equipped with a forced system of bearing lubrication. On the acceptance test this equipment operated with the following consumption of steam:

	Total Indicated Hp.				
	471.5	797	873	958.5	1014
Lb. steam per indicated hp.-hr.	17.8	15.4	14.9	15.6	16*
Corresponding to 26-in vacuum, lb. steam	16.68	14.4	14.03	14.48	14.75

*Vacuum 21 in. to 22.5 in.

LONG-DISTANCE TRANSMISSION AT 11,000 VOLTS

The generators were built by the Canadian General Electric Co., one being wound for 420 volts and the other for 11,000 volts. Sixty-cycle current is delivered from each unit to a main switchboard located at the east side of the engine room parallel to the outer wall of the building.

The switchboard at present consists of six marble panels, two being assigned to the generators, one to a Tirrill regulator and three to oil switching equipment controlling the outgoing service, which is at 11,000 volts, three phase.

The panels are provided with the usual synchronizing equipment, and the layout of the engine room is such as to permit an easy expansion of the plant northward in the future. It is probable that a new 1000-kw. unit, probably a turbo-set, will be installed at an early date.

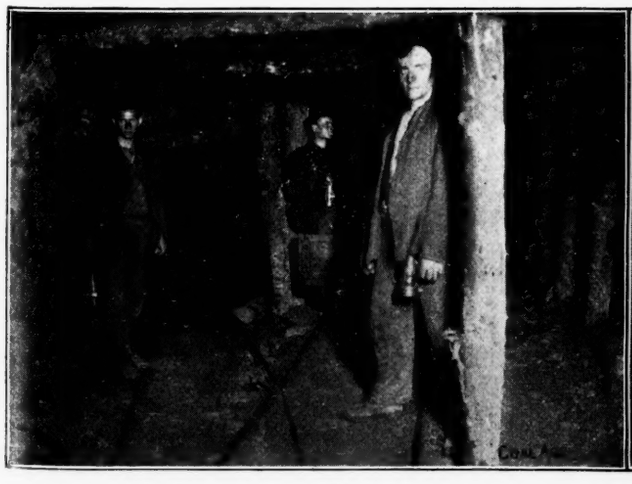
A four-ton hand-operated crane spans the engine room and serves its entire area. Below the engine room are carried two discharge pipes 10 in. in diameter from the condensers to the first dam above the power house, at which point the condensate is returned to the pond.

A homemade cooling tower, designed by W. Cooke, chief engineer of the station, is in use at this point. It consists of two inclined decks about 30 ft. long, the upper deck being bored with holes $\frac{3}{16}$ in. in diameter and 2 in. apart on centers.

Water is discharged upon the upper deck at the head of the tower from the condenser delivery pipes and thrown back into the pond, part leaving the flume in the form of thin sprays falling from the upper to the lower or solid deck, and the rest leaving in a stream at the end of the upper deck, as shown.

The flume is built of 2-in. by 4-in. wooden planking and is braced by bents at three intermediate points. The upper deck has a drop of about 4 in. in 30 ft., while the lower deck drops about 4 ft. in a slightly longer distance.

To avoid washing down the surrounding stream bank, the upper deck is made 2.5 ft. wide at the upper end and 6 ft. wide at the lower end, compared with 3-ft. and 7-ft. widths in the lower portion of the structure.



NO. 3 LANDING AT NO. 7 COLLIERY

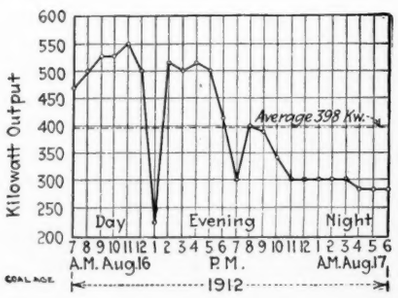
AT THE WORKING FACE, JOGGINS MAIN SEAM

The discharge water is cooled about 7.2 deg. F. in passing over and through the tower, and as the cost of the device and expense of operating it are negligible, there results from its use a positive though moderate economy in the use of injection water.

The Transmission Lines

The local load at Chignecto is handled by a 2200-volt service. From the power house two 11,000-volt overhead lines are run separately to the principal centers of distribution at Joggins and Amherst, each line being built of No. 4 B. & S. copper carried on 15,000-volt porcelain insulators supported on 30-ft. wooden poles spaced 125 ft. apart.

The pole lines are each designed for a second circuit, but at present Joggins and Amherst are supplied by one circuit each. Where the lines cross tidal streams the usual practice is to set two poles close together and employ a ⅜-in. steel cable for the conductor.



Load Curve at Chignecto Plant

At these spans the poles are fitted with double fixtures having four insulators at each end of the span, the spans varying from 400 ft. to 700 ft. in length. At points where the line crosses the track of the Intercolonial Ry. the line conductor used is a 300,000-circ.mil cable.

The poles at these crossings are all set in concrete with an overhead network designed to establish a short-circuit in case the cables break. The Joggins line is about 15 miles long and supplies the Joggins, Maccan and River Hebert districts. All the machinery at the Joggins mines is now electrically operated, distribution being at 220 volts, alternating current.

The largest motor on this line is rated at 95 hp. and drives a ventilating fan for the mining service. The Amherst line supplies energy for all the lighting and motor service in the town, and from this transmission circuit a tap is taken off at Nappan for the Maritime Gypsum Co., a modern substation, for voltage conversion and local distribution, being situated at the mouth of the quarry.

Previous to the installation of electric service the gypsum quarry was not a commercial success, but the use of electricity has turned the enterprise into a profitable one. Local service at Amherst is handled through a two-story 12-ft. by 12-ft. substation.

Amherst Substation

On the upper floor are placed self-cooling transformers reducing the potential to 2400 volts for local use, fuses, switches and low-equivalent lightning arresters. The lower-floor contains 2400-volt oil circuit-breakers controlling the local feeders.

An old direct-current station of small equipment and limited distribution area was shut down by the entrance of the Chignecto service into Amherst, which is a city of about 9000 inhabitants and an active manufacturing community. Among the larger customers of the Maritime interests at Amherst are the McLean Milling Co., Canada Car & Foundry Co., Robb Engineering Co., Canada Works and Hensen Wool Goods Company.

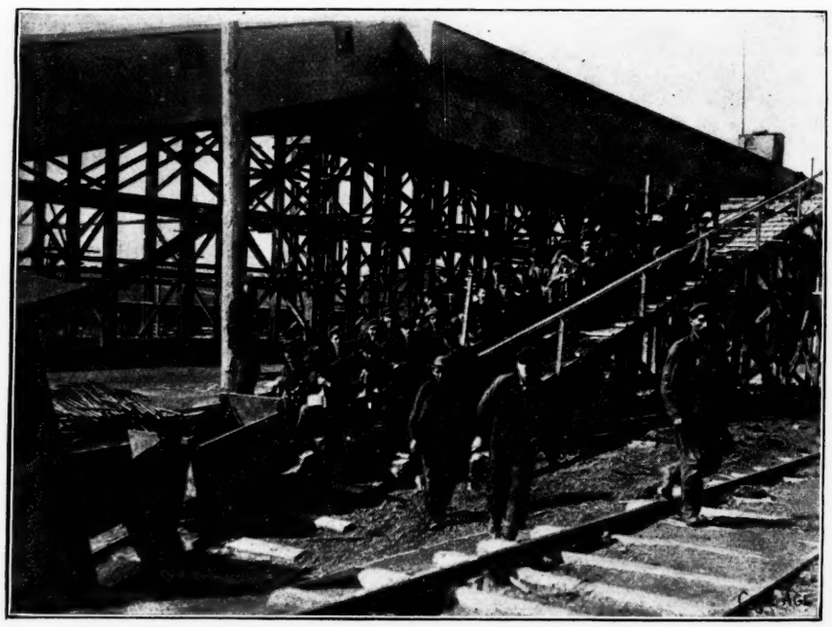
Day and night service is given to all the municipalities reached by the Chignecto plant, and in the outlying districts energy is supplied through local transformer stations of an inexpensive sheet-iron fireproof type, usually mounted out of doors on piling or other wooden foundations.

Thirty per Cent. of Fuel is Ash and Clinkers

The operation of the Chignecto plant requires a force of 10 men. Two shifts are run, these being thirteen and eleven hours in length, with alternate assignment of employees to long and short runs. In the daytime the fire room requires two firemen, one ash wheeler and one man to blow out tubes and clean the boiler combustion chambers.

TEST OF CHIGNECTO BOILER, BURNING REFUSE CULM

Duration of test, hours	7
Grate surface, in square feet (Jones under-feed stoker)	42
Total square feet boiler heating surface	1605
Ratio water-heating surface to grate area	38.1 to 1
Average boiler pressure, lb. per square inch	143.3
Absolute pressure, lb. per square inch	158
Average air pressure in ash pit, inches water	4.65
Average temperature external air, deg. Fahr.	25
Average temperature fire room, deg. Fahr.	50
Feed-water temperature, deg. Fahr.	157.3
Total amount of coal from pile (Chignecto culm), lb.	5506
Moisture in coal, per cent	3.1
Total dry coal, lb.	5534
Total dry weight ashes and clinkers, lb.	1567
Proportion of ashes and clinkers, per cent	29.4
Total loss in coal from all causes, lb.	1739
Total combustible fuel, lb.	3767
Total feed water, lb.	31,358
Equivalent water evaporated from and at 212 deg. Fahr. per pound of coal from pile, lb.	6.291
Equivalent water evaporated from and at 212 deg. Fahr. per pound of combustible, lb.	9.196
Coal burned per square foot grate surface per hour, lb.	18.72
Combustible per square foot grate surface per hour, lb.	12.81
Water evaporated from and at 212 deg. Fahr. per square foot grate surface per hour, lb.	117.8
Above, per square foot heating surface per hour, lb.	3.083
Average hp. developed	143.4
Moisture in steam, per cent	0.75
Approximate heat units in 1 lb. coal from pile as accounted for in water	6078



Changing Shifts at No. 7 Colliery, Maritime Coal, Railway and Power Co.

At night two firemen and an ash wheeler handle the service. In the engine room the chief and an assistant engineer handle the day load, the night shift being carried by an assistant engineer. A typical load curve of the station for a recent August twenty-four-hour run is given herewith, the average output for the period being 398 kw. and the station load factor 72.5 per cent.

The labor requirements are somewhat increased by the care needed to burn the poor fuel offered successfully, without decrease in steam pressure. At present the installation is producing energy upon a fuel consumption of about 6.5 lb. per kw-hr. The average loads upon the plant during the past eight months have ranged from 323 kw. to 398 kw.

Snap Shots in Coal Mining

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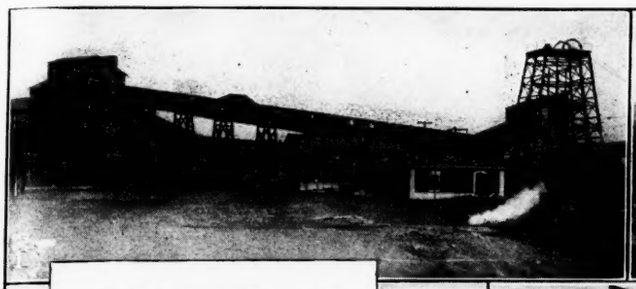


1. Breaker, Headframe and Conveyor Trestle at Prospect Colliery, Wilkes-Barre, Penn. Owned by the Lehigh Valley Coal Co.

2. No. 5 Colliery, Delaware & Hudson Co., near Parsons, Wilkes-Barre District. Left to Right Are Power House, Town, Washer, Breaker and Headframe

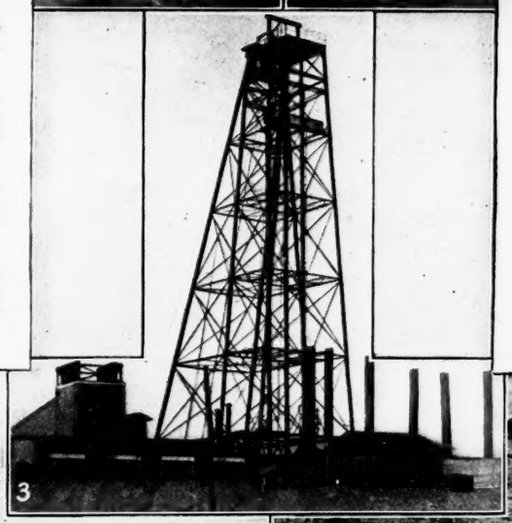
3. Delaware & Hudson Co's Steel Headframe, Pine Ridge Colliery, Miner's Mills, Luzerne County, Penn. One of the Tallest in the Anthracite Region

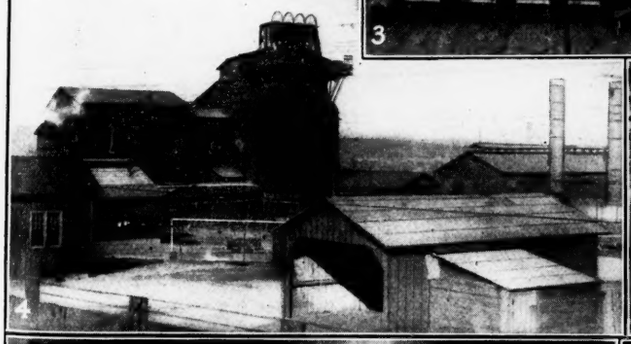
4. Hollenback Colliery of the Lehigh and Wilkes-Barre Coal Co., Wilkes-Barre, Penn. Steel Headframe and Breaker Are Built in Close Proximity

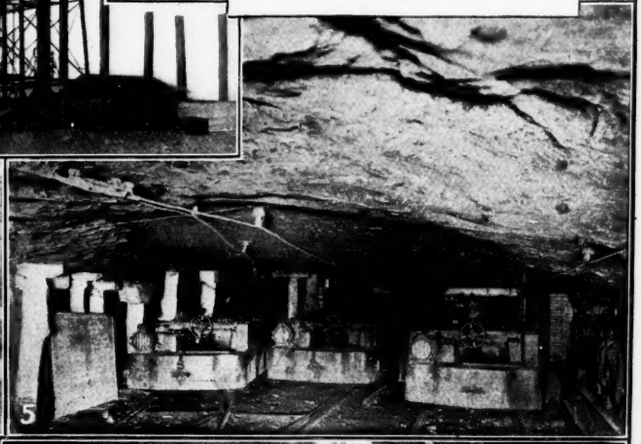
5. A Three Track Underground Motor Barn, Showing Three Electric Locomotives Made by the Jeffrey Manufacturing Co.

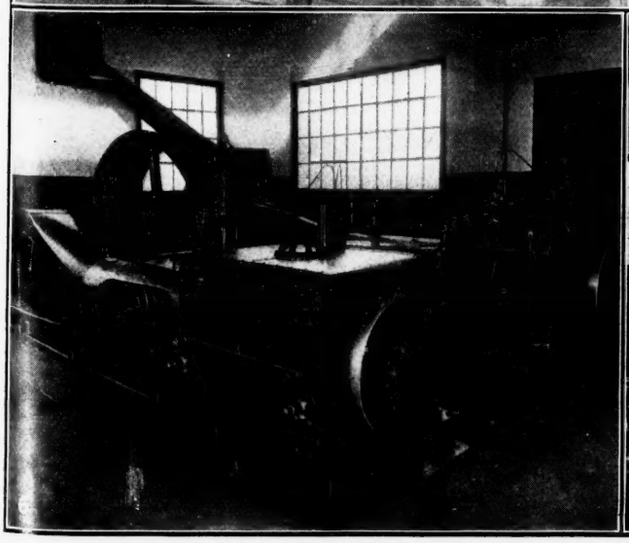
6. A Pair of Heavy Duty 18 x 30-in. Simple Corliss Vulcan Engines Driving the Mineral Spring Breaker of the Lehigh Valley Coal Co. at Parsons, Penn. Shown also in Fig. 7

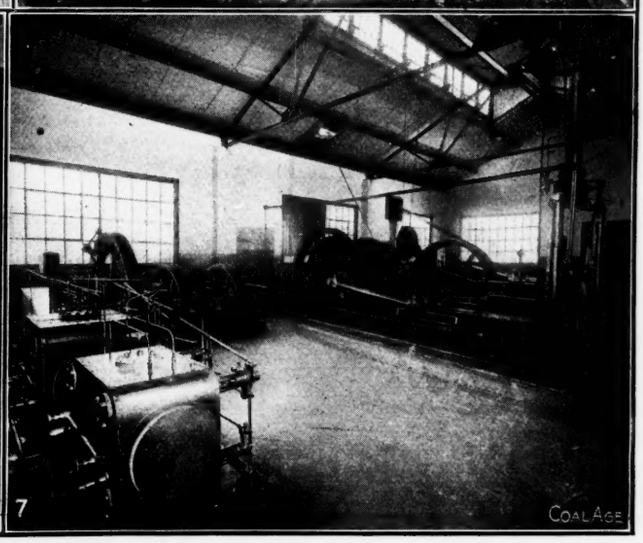
7 Power House at Mineral Springs Breaker Equipped by Vulcan Iron Works with an 11 and 16 x 24-in. Tandem Compound Corliss Engine for Operating Jigs, an Old-style 16 x 30 Geared Tower Hoisting Engine and the Breaker Engine Illustrated in Fig. 6











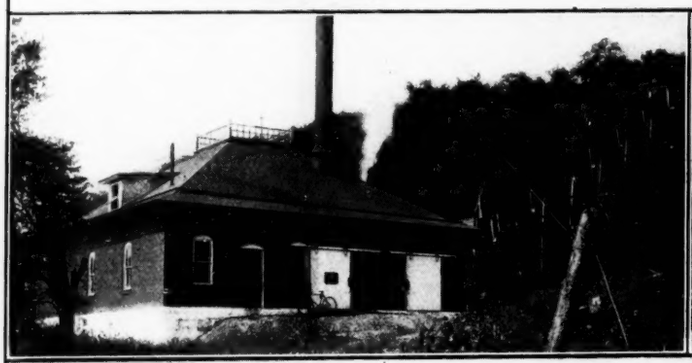
Some Views Relative to Electrical Operation

Hungarian Coke Workers Drawing Ovens

Drawing and Loading Coke by Electricity

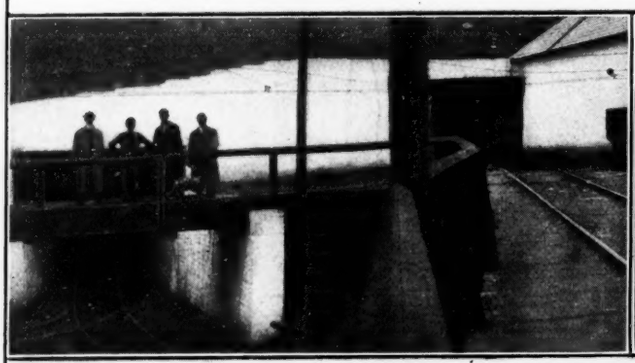
Hobson Mine of the Pomeroy Coal Co., Middleport, O.

Trolley Road through the Woods at the Hobson Mine, Middleton, Meigs County, O

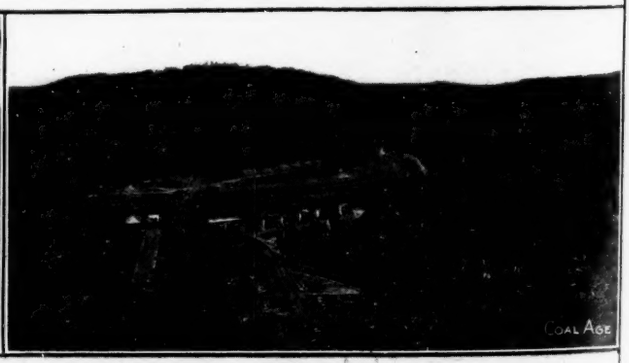


A Neat Power House Belonging to the Pomeroy Coal Co.

Bad Wreck at the Crescent Mine, California, Penn., Grounding the Trolley Wire



Somers Mine of Roby Coal Co. at Adena O. Load Track on Right, Empty on Left



Town of Gary with No. 3 Colliery on the Right: Operation of the U. S. Coal & Coke Co.

Notes on Shotfiring by Electricity

By F. H. Gunsolus*

A description of the current practice in blasting by electricity. The author points out the dangers and disadvantages of the old cap and fuse method as compared with electric firing and prescribes remedies for some of the more common failings of the latter.

*Manager, Technical Division, Sales Department, E. I. du Pont de Nemours Powder Co., Wilmington, Del.

How many coal operators or miners consider the many chances of accident to life and property in detonating charges of explosives by means of blasting caps and fuse rather than by the use of electric fuses fired by blasting machines or electric power circuits? There is no question but what nearly every one has given this subject some thought and study and a few have adopted the method for one reason or another; however, many have kept putting off making a change until some serious accident occurs and considerable money is lost as a result.

Before the Bureau of Mines established a testing station at Pittsburgh, Penn., for the purpose of determining whether or not an explosive was suitable for use in gaseous or dusty coal mines, very little permissible explosives were used. Since that time the use of these explosives has increased materially each year and consequently mine explosions in the United States have decreased.

While the use of permissible explosives is a great aid in reducing mine explosions, there is still another factor, though small in itself, that plays a most important part in increasing safety in coal mining. This is the use of electric fuses, instead of blasting caps and fuse, in detonating charges of permissible explosives.

Accidents with Blasting Caps and Fuses

In the use of blasting caps and fuse accidents occur due to the following reasons:

First—In taking blasting caps from the boxes, accidents often occur due to inserting a nail or wire into the cap which scratches the sensitive explosive and sets them off. Candle grease or small particles of burning wick may fall into the cap and cause an explosion.

Second—Miners often crimp the blasting cap to the fuse by means of their teeth. This is extremely dangerous, as it frequently happens that the loaded end of the blasting cap is slightly crushed, which results in an explosion and the killing or severely maiming of the miner and perhaps any other person or persons in the immediate vicinity. If the miner succeeds in making the crimp without losing his life, it is not securely fastened to the fuse and is not even slightly water resisting.

Third—Another method is to crimp the cap to the fuse with a knife or some piece of metal. This is also dangerous to life and limb, is not a secure means of attachment and is not even slightly water resisting.

Fourth—Miners often put loose blasting caps in their pockets to be carried home, where some member of their family may find them and an accident result due to their ignorance.

Fifth—Miners frequently use a piece of fuse 12 to 15 in. long, commonly spoken of as "short fuse" or "skin-em-back," placing the primer cartridge in the bore hole with an 8- to 12-in. filled tamping bag following. They then ignite the fuse, after which they endeavor to ram the primer cartridge and tamping against the main charge and run for a place of safety before the charge detonates. This is extremely dangerous, as the fuse may burn faster than expected with the result that the charge will explode before the miner has reached a point of safety and he may be injured or killed by flying pieces of coal. Sometimes it will not be possible to ram the primer cartridge against the main charge, due to its striking some obstruction in the borehole. In this case there will be a miss-fire and the consequent dangers encountered in dealing with charges of explosives of this character that must be removed from the coal by subsequent blasts.

Sixth—Another source of danger is the liability of igniting any gas present, due to the spit of the fuse when ignited, or to the side spit while it is burning in the borehole.

Advantages of Electric Firing

All of these dangers can be avoided by using electric fuses and blasting by electricity.

First—Because it is impossible to touch the explosive charge in an electric fuse, as the open end of the copper shell is closed quite securely by the sulphur plug.

Second—Because it is not necessary to crimp an electric fuse, as each one has two wires, 4 ft., 6 ft., 8 ft., etc., in length. These wires can be connected to other electric fuse wires or direct to two lead wires which latter are attached to the blasting machine 150 to 200 ft. distant.

Third—While it is possible to place electric fuses in one's pocket, they are not forgotten as easy as blasting caps because of their bulkiness.

Fourth—Plenty of time can be taken to place the primer cartridge properly in the borehole which can be filled to the mouth with a good damp clay tamping material. This will better confine the explosive and more work will be done with a less amount and consequently at a less cost.

Fifth—As there is no spark or spitting out from an electric fuse there is no danger of igniting the gas from this source.

There are many other reasons against using blasting caps and fuse and for using electric fuses in gaseous or dusty coal mines. Strong objections are often made to using electric fuses, but after the advantages are thoroughly understood there are few who do not adopt them immediately.

Blasting by electricity is generally conceded to be the most effective and economical system, and to surpass any other in safety, expedition and certainty. In work where it is possible to shoot more than one charge at a time it will nearly always be found advantageous to do so.

No method of blasting in gaseous or dusty coal mines, other than the electrical one, deserves consideration. In all others the ignition in the open of some burning substance is necessary, even though a device be used, whereby the safety fuse or squib can be ignited without exposing an open light or flame.

It is believed by many authorities that disastrous explosions in coal mines have been caused by a blownout shot occurring shortly after a number of other blasts have been fired. This cannot happen if the firing is done by electricity, when as many shots as desired are fired simultaneously. In submarine or other very wet work, no other system is feasible. In underground work, where ventilation is not good, the burning safety fuse increases the smoke and fumes quite materially. It is not uncommon for the fire to break through the side of the fuse and ignite the charge of explosives before detonating the blasting cap, resulting in poor execution and an increase of fumes. This cannot occur when the blasting is done by electricity.

Method of Operation

The equipment necessary for electric blasting is as follows:

Electric fuses,
Leading wire,
Connecting wire,
Blasting machine.

A galvanometer and rheostat will also prove of much assistance and very often effect a saving of both time and money.

When the source of the electric current is a blasting machine, or "battery" of the usual type, the boreholes are connected in series; that is, one wire of the electric

fuse in the first borehole is joined (using connecting wire if necessary) to one wire of the electric fuse in the second borehole, and the other wire of this fuse to one wire of the electric fuse in the third borehole, and so on, until all of the boreholes are connected together with a free electric fuse wire in the first and the last holes; these free wires are to be connected to the leading wires and the leading wires to the blasting machine.

When making connections, care must be taken to see that all metal parts joining each other are scraped bright and clean. Another point of particular importance is that no part of the circuit which is not thoroughly insulated should come in contact with any other uninsulated part, or with water or wet or damp ground. In order to accomplish this, all bare joints should be covered with insulating tape. When making connections, do not loop the wires, but twist them tightly together.

The attempt to use an old and damaged leading or connecting wire, is a great mistake and often the cause of missfires. One of the principal objections to their use is that the wire itself frequently breaks inside the insulation, which will remain intact. When this occurs, the ends of the wire may touch and the circuit seem all right when tested, but a very slight movement afterward may pull these ends apart, breaking the circuit and causing a missfire. A break of this kind is not easily located, and sometimes is responsible for the loss of the time of many workmen waiting for the shot to be fired.

The storage of electric fuses should always be given careful attention by the consumer. If they are permitted to remain for a considerable period of time in a very warm place, the water-proofing material in the insulation dries out to such an extent that the insulation may break when the wires are bent, and missfires result if an attempt is made to use them in wet work.

The explosive charge in the electric fuses is easily affected by moisture, and if they are stored in a damp or wet place they may deteriorate. This charge is also quite sensitive, and may be exploded by a moderately hard knock or jar. Careful handling is also necessary on account of the delicate bridge wire, which may be broken, and which renders the fuse absolutely useless. The wires must not be bent sharply or forcibly separated at the point where they enter the copper cap, as this may break or loosen the filling material and permit water to enter and damage the charge in the electric fuse.

Priming the Cartridge

The correct way to prime a high-explosive cartridge with an electric fuse is to unfold the paper on one end of the cartridge and insert the fuse cap in the center, pointing it directly toward the opposite end; then fold the paper about the two wires, and tie it firmly with strong twine. The primer may also be made by inserting the fuse cap in the side of the cartridge near the end, and pointing it downward toward the opposite end, the wires to be tied to the side of the cartridge. The electric fuse should always be placed so that the loaded end will point toward the main portion of the charge it is to detonate.

The hole for the fuse cap should be made in the cartridge with a pointed stick about the size of a lead pencil. The common custom of taking one or more loops, or half-hitches around the cartridge with the wires themselves, after inserting the fuse cap in a hole made diagonally in the side of the cartridge near one end, is always to be condemned. The principal objection is that the looping of the wires may break the insulation, causing short-circuits or leakage of current in wet work, or may even break the wires themselves. Also, when a fuse cap from 1⅜ in. to 2 in. long is pushed into the side of a cartridge 1 in., 1¼ in., or even 1½ in. in diameter, it often happens that the point, where the principal part of the detonating charge is located, goes entirely through the explosive itself, even though it may not break through the paper.

As it is often the custom, when priming in this way, to point the fuse cap diagonally toward the end of the cartridge, which will be nearest the outside or top of the charge, it can readily be seen that any pull on the wires, hard enough to affect the position of the cap, will tend to bring it more to a right angle with the long axis of the cartridge, and thus force the point still farther out of the opposite side. While this does not always cause a failure, it is quite possible that lost shots may be attributed to it, especially when cartridges of small diameter are used.

Variety of Wires

Care must be taken, when tamping the borehole, not to break either the electric fuse wires or the insulation on them, or to pull the electric fuse cap out of the primer. Many missfires are probably due to carelessness in loading and tamping boreholes.

Although electric fuse wires are well insulated, they are not intended for extreme conditions, and if used in water, particularly under pressure, they may "leak"; that is, the electric current or a part of it, may "short-circuit" instead of passing through the bridge wire, which is of high resistance. Therefore, more current is necessary to insure good results in wet work than in dry work, unless electric fuses with special insulation for wet work are used. These specially insulated fuses are called Victor Waterproof Electric Fuses.

In order to reduce the expense of electric firing as much as possible, electric fuses with iron wires are manufactured for this purpose. They may also be used on other work where fuses with wires longer than 8 ft. are not required.

Electric fuses with iron wires cost less than those of copper, but will not prove satisfactory under all conditions of electric blasting. The principal reason for this is that iron wire, even when in good condition, is much inferior to copper as an electric conductor. Practically six times as strong a current is required to fire a shot with iron wires as will fire one with the same length of copper wires. Iron wire also corrodes much more readily than copper.

The Blasting Machine

Some of the means used in detonating electric fuses are blasting machines of various capacities, electric power circuits or dry-cell battery. The first two mentioned are considered more reliable, due to the fact that a battery will deteriorate very fast whether it is kept in use or not.

There are many kinds and styles of blasting machine manufactured which are suitable for use in gaseous or dusty coal mines. Some have a capacity of firing three electric fuses connected in series, while others will fire 10, and so on up to 100 fuses in series. As there are very few cases in coal-mine blasting where it is necessary to fire more than three electric fuses at one time, it has been found that the smaller machines give satisfactory results.

Remember that good care will prolong the usefulness of the blasting machine, will reduce the necessity for repairs and will help to maintain its efficiency. The bearings and gearings should be lightly oiled occasionally, but on the commutator, which is the small copper-covered wheel on the end of the armature shaft, use a little graphite, but never oil. See that the two slots cut in the copper part of the commutator are clean, and with no particle of metal or anything else in them which might cause a short circuit. Keep the copper brushes clean, and see that they bear firmly on the commutator. Keep the circuit-breaking contacts clean and bright.

When a blasting machine is not in use, store it in a dry and comparatively cool place, not in a leaky tool box or on top of a boiler.

In some instances it is found that coal mines are being wired for electric lighting and electric haulage. If this system is carried a little further without much extra expense, arrangements can be made to successfully fire charges of explosives by electricity. This can be arranged so that none of the firing would take place until all of the miners had left the mine and even then only charges of explosives in certain portions of the mine could be fired, as desired by the operator.

Modern Practice in Mine Telephones

By Gregory Brown*

An interesting paper on approved methods of installing mine telephone equipment. The requirements of instruments for underground service are reviewed and an excellent type of machine is described. The problems of insulation are discussed, and some valuable devices for use in this connection are shown.

*Telephone expert, 463 West St., New York City.

Mining methods have changed and improved during the last decade probably to a greater extent than has been the case for the previous hundred years. Undoubtedly, the one greatest factor having to do with this great increase in economy and efficiency of operation is the application of electricity. The ordinary uses of electric current may be divided into three classes—Power, Lighting and Communication—and a large number of the coal mines of this country are taking full advantage of these three kinds of service.

Much has been said about electric power in mines, such as hauling, pumping, coal cutting, etc. Also about the electric lighting of mines and portable electric lamps, but comparatively little has appeared in the technical press concerning the use of telephones both below and above the ground.

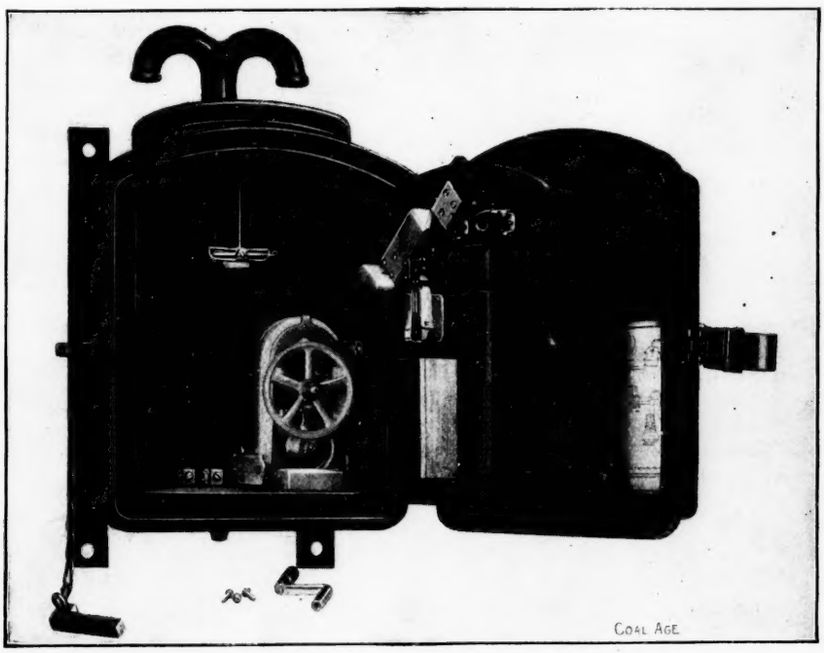


FIG. 1. A GOOD TYPE OF UNDERGROUND TELEPHONE

The installation of electric power by the mines represents a very large investment, but this is amply justified by the increased economies of operation. The investment of the mining companies in telephone systems is, of course, a good deal less than in power apparatus, but I venture to say that, measured from the standpoint of return on the investment, a telephone system is at least as profitable, if not more so.

ITS USES IN MINE SERVICE

We all know what a tremendous economic saving was introduced by the general use of the telephone in ordinary business affairs, and this saving may be epitomized in just two words—"Steps Saved". If this is true when applied to the ordinary use of the telephone, how much more is it true when applied to a mine in which the steps saved are infinitely more difficult to take?

Not only is a telephone system an actual necessity in the efficient operation of a mine but it is also of great use in emergencies and accidents; in fact it is not too much to say that the telephone is the greatest help that the mine operator has in his fight to reduce the loss of life which seems to be more or less inherently connected with mining operations. By this I do not mean to infer that the installation of telephones will prevent falls from injuring or killing a man, but when a man is injured the telephone will instantly summon help. In case of fire the telephone furnishes a means for warning all the men in the mine and directing their escape, while in cases of explosion some of the instruments can still be used for warning and directing.

The general use of telephones in mines is of comparatively recent origin, and when they were first installed it was thought that there would be no trouble about using the ordinary commercial wooden type of instrument. It was soon found, however, that this type of telephone would last but a very short time in the average mine. The dampness and corrosive action of mine water would soon warp the woodwork and attack the pieces of apparatus in such a way as to render them useless in a short time. On the other hand, in some few dry mines and under good conditions, the wooden telephones lasted for a fairly long period. These cases were more or less exceptional, however, and it soon became evident that it would be necssary to develop a special instrument that would be capable of withstanding the severe mine conditions.

TYPE OF MINE TELEPHONE

In Fig. 1 is shown a cut of a modern mine telephone of the Western Electric Co. type. It will be noticed that the apparatus is enclosed in a substantial cast-iron case, which is heavily japanned.

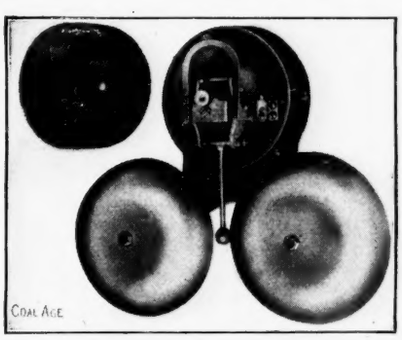


FIG. 2. EXTENSION BELL

This case contains two doors. The outer one protects the transmitter mouth-piece, receiver and generator crank, while the inner protects all the apparatus within the box.

This set is electrically the same as an ordinary magneto instrument, but the mechanical construction is markedly different. Besides being encased, every piece of the apparatus is individually and thoroughly protected against the inroads of moisture and corrosive mine water.

The cut shows the induction coil, mounted in a wooden box, fastened to the inside of the inner door. This box is made of maple, boiled in paraffine and fastened with brass screws. The induction coil is carefully dried and then impregnated with a moisture-proof com-

pound, after which it is placed in the box, which is completely filled with a sealing compound. All exposed terminals are also covered with this sealing compound. The wiring of the set is of high-grade rubber-covered wire, formed into a cable and impregnated. The cable is then carefully taped and impregnated a second time.

The ringer coils, generator armature and receiver coils are also treated in this manner as well as the batteries. This latter is an important point, as the carton or cardboard case of the ordinary battery quickly becomes damp, which causes the batteries to short circuit and run down rapidly, even when they are not in use.

Method of Installing

This set is often used in connection with a loud ringing bell instead of the small ringer shown in the cut. A good type of this class of bell is shown in Fig. 2. The gongs are heavily galvanized, all other metal parts specially treated and the windings impregnated. The use of extension bells is often advantageous, not only on account of the loud signal, but because the sets can be mounted in a more or less sheltered position and the bells placed in the most convenient location for giving the signal.

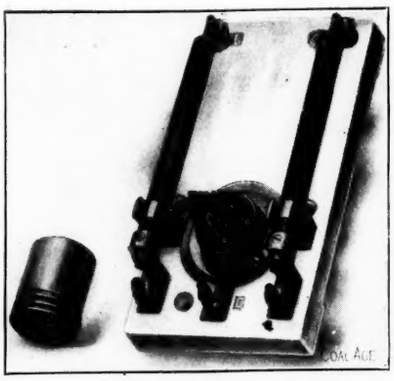


Fig. 4. Lightning Protector

The telephone systems in use in the majority of mines are what are known as "party-line systems". That is, all the telephones are connected across a single pair of wires. For the benefit of those who are not familiar with telephones, there is shown in Fig. 3 the circuit of a typical system. It will be noted that all the telephones underground are the iron-type mining-sets, while those in the buildings above ground are the ordinary commercial magneto instruments. There is generally supplied for the superintendent and manager's use, both in the office and at his residence, desk telephones, and in the engine room, repair shop, etc., as well as in the foreman's residence, the ordinary wall type of telephone.

All instruments on the circuit are what are known as the 5-bar, 2500-ohm type; that is, the generator for furnishing the ringing current contains five permanent magnets for furnishing the magnetism to generate the alternating current and the ringers are wound to 2500 ohms. With this combination it is possible, on a good line, to ring as many as forty bells. However, on account of the fact that the dampness in the mine causes more or less leakage between wires, this is not a safe number to operate on one circuit. About 20 to 25 instruments on a line of average insulation in a mine will operate satisfactorily.

Lightning Protectors

It will be noted that at each of the instruments above ground, there is placed a protector. This device is shown in Fig. 4. It consists of fuses for each side of the line, and also a spark gap arrester. This arrester consists of four blocks of carbon or metal, the two outside ones being connected to each side of the line and the two middle ones to ground. The outside blocks are separated from the inside ones by means of a piece of perforated mica .005 in. thick.

It will be seen that this arrangement provides a gap from each side of the

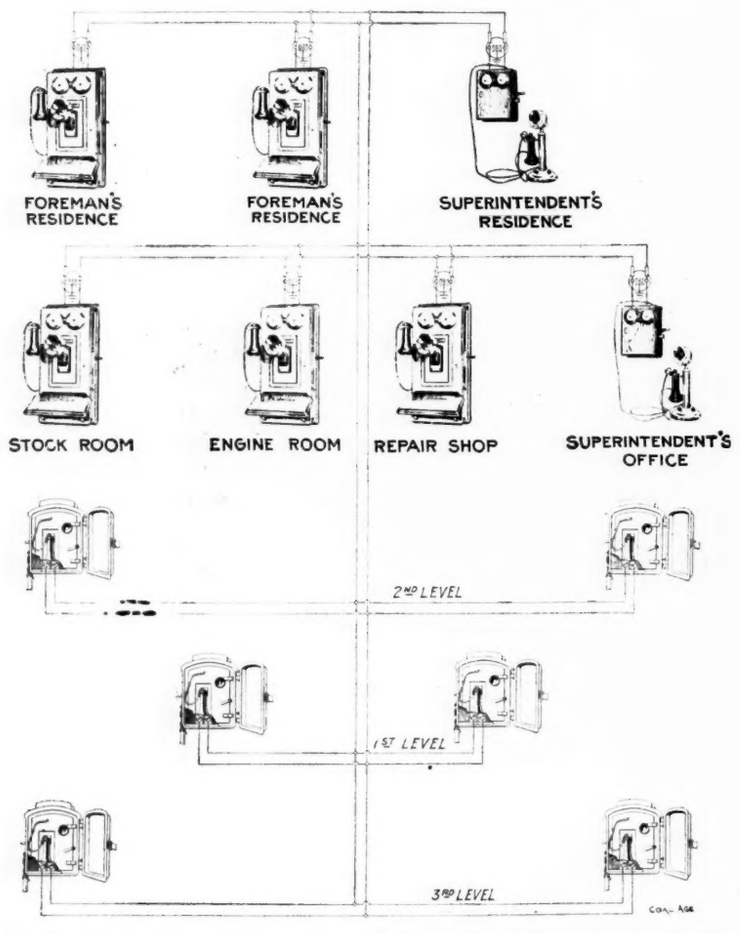


Fig. 3. Diagrammatic Layout for a Typical Mine Telephone Service

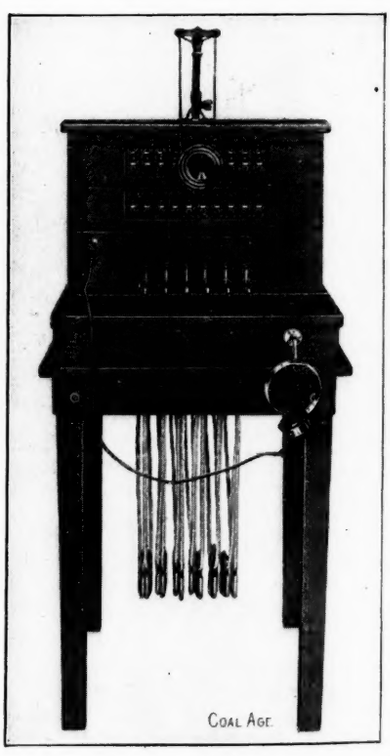


Fig. 5. A Small Switchboard

line to ground of 0.005 in. During an electrical storm, the wires are often affected by the induced voltage of lightning and become heavily charged. When this occurs the high voltage will cause the current to jump the air gap to the ground, instead of going through the telephone instruments and thereby causing damage or destroying them. If the amount of current flowing is heavy enough, the fuses will blow when the current jumps to the ground, thus cutting off the instruments from the line and avoiding danger to the operator. Besides placing protectors at each of the instruments above ground, it is customary to place one at the top of the shaft which protects all the instruments in the mine.

Some companies have several party lines instead of placing all their instruments upon one, these being entirely above ground, and connecting together the various buildings and offices. This is done usually where the company owns or leases trunks or long distance lines reaching to their main offices in some city. In fact, there are several large companies whose telephone facilities are such that they can talk from their offices, seventy or eighty miles from the mines, to any of the underground stations.

In order to operate several lines and have trunk connections, it is necessary to install a switchboard and Fig. 5 shows a type which is extensively used. Turning the generator on any line will cause the drop to fall, and the operator by means of plugs and cords furnishes the desired connection.

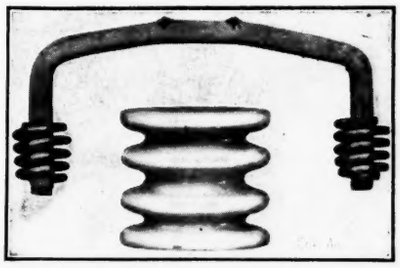


FIG. 6. A NEW STYLE INSULATOR

INSULATION

On account of the severe conditions in mines, due to moisture, corrosive mine water, coal dust, etc., it is necessary that special pains be taken in putting up the conductors. A great many of the mines use bare copper or bare iron wire. The copper is, of course, somewhat more expensive but is less subject to corrosive action.

One of the principal difficulties encountered in insulating the bare wires is due to the fact that a film of moisture will form on the insulator, which produces a partially conducting path to ground. One way of reducing this tendency is to use an insulator and bracket of such a type that the length of the leakage path to ground is as great as possible. One of the larger companies is putting on the market a type of bracket and insulator which is small and compact but so designed that the leakage path to ground is of considerable length. The bracket and insulator are shown in Fig. 6.

The bracket is a modified form of a standard insulator which has been used successfully for a number of years, and is so arranged that it can be applied under almost any condition in a mine. One good feature of this bracket is that in cases where it is fastened directly to the roof, it is necessary to drill but one hole. A 5/8 in. extension bolt will fasten it firmly in place, or a wooden plug and 5/8 in. lag screw makes a firm fastening and is somewhat cheaper. Where timbers exist, it can be fastened directly to them by means of a lag screw.

For signal wires for rope haulage, the distance between the wires is just about right and it forms a convenient method of supporting these conductors. The insulator is corrugated in such a way that the leakage path to ground is of considerable length; in fact, greater than other insulators of the same size which have heretofore been used for this purpose.

Besides the use of bare wires, braided rubber-covered wire has been extensively used and good service obtained. A somewhat more expensive type of conductor, but one which is more desirable, is the circular loom cable. This cable is mechanically protected by a heavy fibrous coating and contains a twisted pair of wires, whose insulation is high-grade rubber. This cable is used extensively, particularly in shafts.

New Arrangement in Mine Hoisting

By H. K. English*

At an Iowa coal mine, the electric hoist, employing herringbone gears, is placed on the ground. The man operating this machine is stationed in the scale-house near where the cages dump. The hoist-man, therefore, since none of the usual signals or indicators are dispensed with, has the additional advantage of being able to watch the process of car discharge.

*Electrical engineer, Ottumwa Iron Works, Ottumwa, Iowa.

There is in process of erection for the coal department of the Rock Island Railway, near Dallas, Iowa, a coal mining plant which embodies many striking details. The entire installation is uptodate, but the electric hoist, ordered by President Carl Scholz from the Ottumwa Iron Works is the most unique feature.

The power house contains two 300-hp. water tube boilers equipped with chain grate stokers, the coal being supplied by gravity from a large storage bin.

Electric current is generated at 2300 volts in Curtiss turbo-generators. These machines are operated condensing, surface condensers being employed, cooling water for which is obtained from a nearby pond. For underground use, this high-voltage, alternating current is converted into 250-volt direct current, by means of motor-generator sets.

DESCRIPTION OF HOISTING ENGINE

The principal point of interest about this plant is the hoisting arrangement, which embodies many peculiar features. The hoist itself consists of a single drum 60 in. in diameter grooved for 1 1/8 in. rope. One end of this drum is supported by and securely bolted to the spokes of the main gear, lugs being provided for this purpose. The rotating unit thus formed is rigidly keyed to the main shaft, which is supported by bearings of unusually liberal design cast into the main frame.

Entirely surrounding the drum and gear is a heavy cast-iron frame of box girder section. To one side of this frame is bolted the motor bedplate. The latter extends for a short distance under the main frame, two of the foundation bolts for which pass through the bedplate also, thus anchoring the two rigidly together. The general arrangement of hoist and motor is illustrated in Fig. 1 while the main gear and pinion is shown in Fig. 2.

The speed reduction between the motor and drum is accomplished through a cast-steel gear meshing with a high-carbon forged steel pinion of the "Wuest" herringbone type. The motor is provided with an extended shaft and outboard bearing so that the pinion which is rigidly keyed to it is firmly supported on each side.

On one end of the cable drum, there is provided a double brake seat on which two sets of post brakes operate.

Each of these brakes is of the air-actuated gravity type; that is, it is set by the action of dead weights and relieved by means of an air cylinder.

Power is supplied to this hoist by a General Electric Co. 16-pole, 300-hp., 3-phase, 60-cycle, 2200-volt, slip-ring type, induction motor operating at 450 r.p.m.

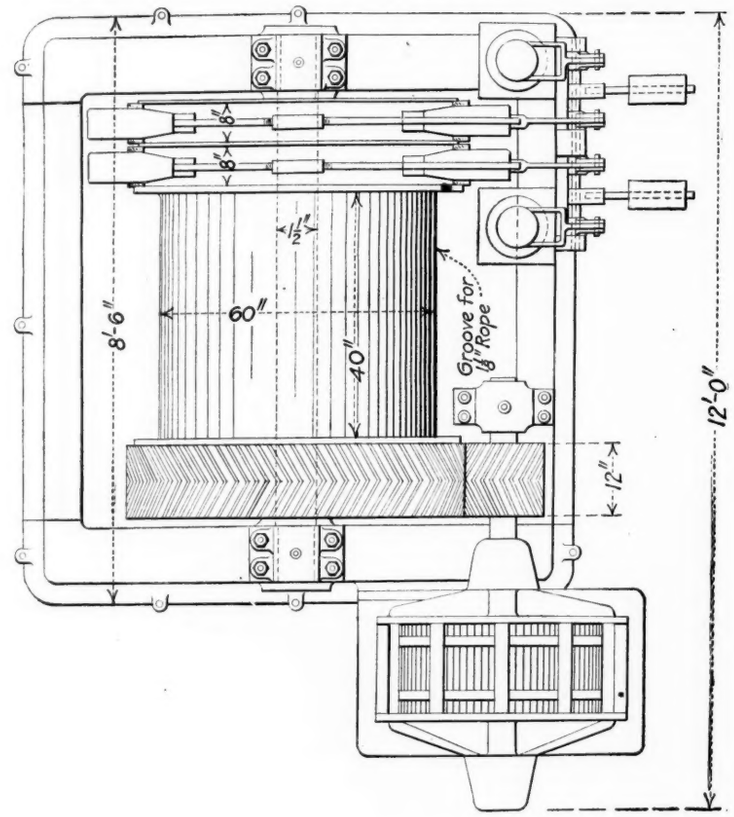


FIG. 1. GENERAL DRAWING OF HOIST

One familiar with hoists will at once notice from Fig. 1 that this machine is not provided with operating platform or levers of any kind. The reason for this is that the driver will not be stationed at the hoist, but will have perfect control of same from his position in the scale house in the tipple. The motor itself will be operated by a master controller, through a contactor panel which is situated in the hoist house on the ground, adjacent to the motor. The necessary rheostats, or resistance boxes, will be located in the hoist house. By this means, any desired rotation from standstill to full speed in either direction may be obtained.

The brakes will be controlled through standard motorman's air valves, similar to those used on large street and interurban electric cars. Through these the operator will apply the brakes to his hoist in such a way as to bring it to a standstill in any desired time and without shock to any of the moving parts..

The hoistman in the scale house will at all times be informed as to the position of the cages by means of an indicator which is driven from the shaft of the sheave wheel at the top of the tipple. He has, therefore, as perfect control of the hoist as if he were located beside it and, at the same time, has the great advantage of being able to see exactly what he is doing in landing the cages and dumping the coal. But, although he can thus always observe what is going on, none of the ordinary signals will be dispensed with.

Mention has been made of double brakes. One of these only is ordinarily controlled by the operator in the scale house; the other being an emergency brake which will be automatically applied in case of overwind. This latter can, however, be thrown on by the driver at any time in case of failure of the service brake. It is controlled by a solenoid-operated air valve.

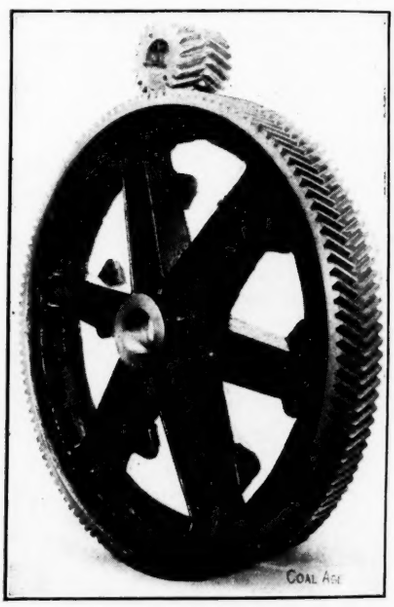


FIG. 2. MAIN GEAR AND PINION

In case of overwind, the circuit of the electric current in the solenoid is broken, which causes the valve to act, applying the brake. Should the operator desire to use this brake, he can do so by simply throwing a switch.

In connection with this rather unusual arrangement, it might be mentioned that there is no more excuse for putting an operator adjacent to an electric hoist than there would be for placing the man running an elevator in a city office building in the basement alongside the motor. We would venture to predict, therefore, that, while this is one of the first electric hoists to be located at a coal mine employing this method of control, as soon as the advantages of the same are fully understood, there will be many more thus installed.

Remedies for Electrical Troubles

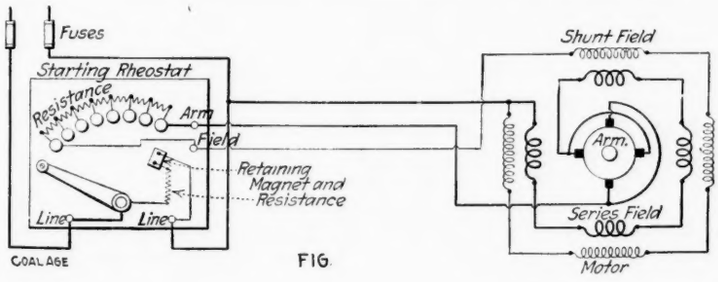
By E. Clemens*

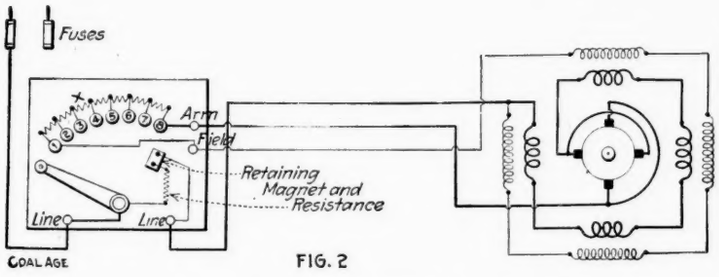
In this article, the writer, who has had a broad experience in this particular field, describes the principal troubles to which small direct-current motors and generators are subject, and gives a number of novel emergency treatments for same.

*Electrical engineer, United States Coal & Coke Co., Gary, W. Va.

After having had charge of the electric equipment of a number of mines for several years, the writer has had an opportunity to see many simple and some deceiving break-downs, also many emergency and some proper repairs, made by men of the average class generally found around an electrically-operated coal mine.

In this discussion it is assumed that the electric equipment has been installed in perfect working order, but in course of time small break-downs begin to occur. These are caused from lack of attention, worn out parts, too much dirt and grease, defective repairing, or burnouts due to electrical or mechanical weakness. Satisfactory operation is therefore no longer possible, and emergency treatment must be employed in order to keep this part of the equipment in operation until material arrives or time can be taken to make permanent repairs. Direct current motors and generators up to about 50 hp. will be considered, such as are generally used on small mine pumps, fans, tipple machinery or various other appliances used around a coal mine.





RIGHT AND WRONG MOTOR CONNECTIONS

ENUMERATION OF SERIOUS TROUBLES

The more serious defects that generally appear are as follows: 1:—Sparking at commutator; 2:—Over-heating of armature or field coils; 3:—Grounds; 4:—Wrong polarity; 5:—Excessive speeds; 6:—Armature fails to start, and numerous other lesser troubles that will be mentioned later.

Each one of the above six defects can be subdivided. The various causes which may produce sparking with proper and emergency repairs are as follows: 1 a:—Flat spots and ridges. The proper cure would be to turn down commutator with a cutting tool or trueing device or by putting armature into a lathe. In the early stages of the disease a free use of sand paper fastened to a block which is cut out to the same curvature as the commutator will be of some service. Good work can be done with a piece of sand stone, by driving armature at nearly normal speed and, in a generator raising all brushes; in a motor remove all load and apply sufficient voltage to bring armature to nearly normal speed; then either hold sand stone on commutator or for larger machines fasten it to a guide so that it can be moved back and forth parallel to the shaft. This grinding process should be kept up until all ridges and flat spots disappear, after which the armature should be blown out thoroughly to remove all dust and grit.

1 b:—High mica between commutator bars. The proper remedy is to take a hack saw blade and cut mica down to from 1/32 to 1/16 in. below the surface of the copper segments; the same temporary cure can be used as in 1 a.

1 c:—Brushes set too far from neutral. The proper cure is to get a low-reading voltmeter and run motor at no load with normal voltage, holding the points of voltmeter leads about the width of a bar apart on the commutator, and noting the reading on the meter; shift the leads back and forth on commutator until a point is reached where the instrument records the lowest reading. In a commutating pole or reversible motor set the brushes permanently at this point. This would also apply to a series-wound motor. In other than the above stated types, move the rocker arm back slightly, opposite to the direction of rotation of armature; if a generator move rocker arm forward in same direction as that of the rotation.

Another method that can be adopted when no voltmeter is at hand is to make several trials of shifting the rocker arm which carries the brush holders both forward and backward for a few bars noting the commutation meanwhile. The brushes should be set where the least sparking takes place under normal operating conditions.

Another method is to run the motor both forward and backward with the same applied voltage; if the speed is the same in both directions the brushes are very close to neutral.

Still another method is to select any armature coil, move armature around until the slots in which this coil lies are symmetrical with respects to the pole tips, then trace coil leads down to the commutator; by setting brush on the bars to which these leads are connected a position is secured which one can confidently assume will be very close to the electrical neutral (See Fig. 7). In both of the latter methods no load on motor is assumed. A slight backward movement of brushes must be made for full load conditions in a motor, or a forward movement in a generator.

1 d:—Grounded armature, field, or brush holder. The only permanent cure is to replace the grounded part of apparatus. Emergency repairs for one or two armature coils, would be to disconnect both ends of defective coil from commutator and close the circuit again as will be explained in 1 e.

In most compound-wound motors it is possible to run with one or even all series field coils cut out, or it is possible to run with one shunt coil cut out. When any

of the coils are removed or short circuited a jumper must be connected to the remaining coils so that the circuit will be completed through those remaining in series.

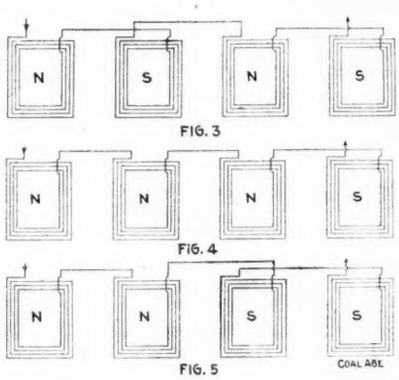
In small multipolar motors having the same number of brush holders as there are poles, if a brush holder becomes grounded it can be cut out and the motor operated without it. All these suggestions are only emergency repairs and much care should be exercised on motors which are normally run at full load or over-loaded, as disastrous results may follow.

It sometimes happens that an armature gets grounded without showing any visible signs of a burn, in such a case the following simple little test may be of considerable service in locating the ground. All that is needed is a few dry batteries, a small buzzer, a telephone receiver and some small wire (See Fig. 8 for connections). Proceed as follows: After you see that the buzzer is working properly, hold telephone receiver to your ear and notice the hum; move the lead marked "X" from telephone receiver and again notice hum. Continue this around commutator, and as the bar to which the grounded coil is connected is approached the sound in the receiver will decrease. The bar on which the least hum in the receiver is noticed will lead to, or very close to, the grounded coil.

1 e:—Open circuit in armature winding. This can usually be very easily detected on examining the commutator. The mica and the inner edges of the commutator bars adjacent to mica will be pitted out as much as 3/64 or 1/8 in. deep where the open circuit is located. Emergency repairs would be to connect bars between which mica is pitted out together and thus close the circuit again through the armature.

If, upon close examination, no signs as above stated can be found, by connecting a battery and buzzer as shown in Fig. 9 and testing with a telephone receiver it can be located as follows: The telephone receiver leads are held on adjacent bars of commutator all the way around; where the circuits are good the hum in the receiver will be of practically the same tone, but when the leads span an open circuit a very decided increase of sound will be heard.

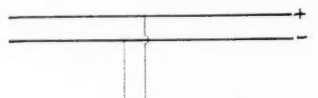
If the coil in which the open circuit exists is located but repairs can not be made, or if the coil has been disconnected due to a ground, and it is important that the armature should be put in operation it can be repaired temporarily as follows: Assuming for instance, that the armature has a two-circuit progressive winding with 87 bars in the commutator, (referring to Fig. 10), the throw of a coil on the commutator is 1 to 44; that is, one end of one coil connects to bar No. 1 while the other end of the same coil is joined to the 44th bar. Assume the coil connected to bars 2 and 45 gets grounded. Disconnect both ends of coil as shown at "X" which leaves the armature open circuited. Then connect the 2d and 3d bar together also



CORRECT AND INCORRECT POLARITY

the 44th and 45th. The armature will now run but at a somewhat increased speed.

1 f:—Sparking may also be due to some mechanical action which disturbs the brush contact at a particular point in each revolution of the armature, such as a badly laced belt, a defective tooth in a pinion or gear, loose bearings, wide variations of load during each revolution of armature such as is frequently encountered in the operation of air compressors and reciprocating pumps, brushes sticking in brush holders or an unequal spacing



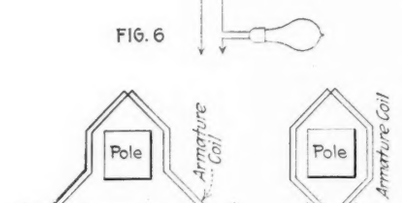


FIG. 7

TEST LAMP CONNECTIONS AND THE SETTING OF BRUSHES

of these parts, spring tension on brushes too weak, or brushes too short so that poor contact is made on commutator. Close observation and study will detect many of these defects and generally speaking the only cure is to remove the cause.

1 g:—Open circuit in shunt field. An open circuit in a field coil is generally due either to a lead breaking off close to the coil, or to a ground which burns off one or more wires. In case of a broken lead the insulation on the coil can usually be cut back so that the lead can be spliced out, and in case of a ground that has burned one or more wires in two, by noticing the way the wires lie in the layer the ends can be connected together, which will close the circuit through the field. This may cut out several turns or even layers of one coil and yet the motor will operate very satisfactorily, although it will cause the temperature of the fields to increase somewhat.

1 h:—Wrong connections. The improper connections between motor and starting apparatus often made by inexperienced men may cause vicious sparking, excessive speed or even failure of the armature to start at all. No fixed or set rules can be laid down that will apply to all makes of motors used for various purposes, and started under different conditions. A general idea may be had as to how to connect a motor from Fig. 1. Notice that the shunt field is wound from fine wire and is connected across the line, the series field on the other hand, is wound with heavier wire and is in series with the armature. Also notice that the armature must have a certain amount of resistance connected in series with it for starting. This is the function of the starting rheostat.

1 i:—Excessive overload. This has no remedy except removal.

HOW OVER-HEATING MAY BE CAUSED

2:—Over-heating of motor.

2 a:—This may be due to open circuit in shunt field (especially in a compound wound motor) and running it as a series motor. A part of the remedy given in 1 g can be applied. To locate open circuit in shunt field circuit, connect up a test lamp as shown in Fig. 6 and touch the terminals of field coil with those of the test lamp. If the lamp burns the coil has a closed circuit, but if not it is open circuited. In cases of emergency a jumper of proper size can be connected across the defective coil and motor will run at an increased speed. Close attention must be given the motor, especially if well loaded up to its capacity, as it will heat considerably.

2 b:—Over-heating due to open circuit in starting rheostat. Referring to Fig. 1, if an open circuit should develop at a point between the 3d and 4th contact button, the motor would not start until the contact lever had passed this brake in the resistance. Then in all probability it would start, drawing an excessive current from the line and causing heating due to shunt field circuit being open at the point of interruption.

Temporary repairs would be to connect

the armature and shunt field leads together. This would cause motor to start with a jump, after the lever had passed the break in resistance which would be objectionable for some classes of work.

2 c:—Over-heating due to other causes. With a short circuit in one or more of the shunt field coils, those remaining cool are defective. Over-voltage will

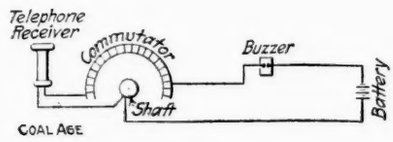


FIG. 8

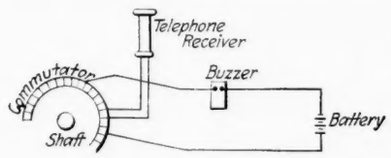


FIG. 9

cause heating; all coils being equally affected. Reversed polarity will also cause an excessive rise of temperature. A rough commutator, poor brush contact, armature rubbing on poles and tight fitting bearings will all have a like result.

GROUNDS AND WRONG POLARITY

3:—Grounds.

3 a:—1 d covers most grounds that are found in general.

4:—Wrong polarity.

4 a:—Wrong polarity only occurs when field coils are changed or replaced. To an inexperienced man all coils look alike. They are consequently put in and connected alike with the result that the polarity is frequently reversed. If no compass is at hand a very simple one can be made with a small piece of steel wire 2 or 3 inches long. Mark one end so that it can be easily identified, suspend from the middle on a thread and proceed to test as follows: Apply proper amount of current to field coils by putting full line voltage across the shunt windings, and for series coil testing a temporary resistance must be connected in so as to reduce current to full load amount. Test each kind of coils separately. After current is applied take a short hold of the thread and suspend wire fairly close to face or near ends of coil, and note which end of the wire is attracted. Every other coil should attract the same end of the wire, while adjacent coils must attract its opposite ends. Both series and shunt windings on one magnet must be of the same polarity and attract the same end of the wire, except on some special motors where the series coils oppose the shunt. Fig. 3 shows the correct arrangement of polarity while Fig. 4 and 5 are frequently found and are both wrong.

5:—Excessive speeds.

5 a:—Excessive speeds may be caused by excessive voltage.

5 b:—Open circuit in shunt field circuit, see 2 a, 2 b and 1 g.

5 c:—Reversed polarity, see 4 a.

5 d:—Wrong setting of brushes, see 1 c.

5 e:—A badly short-circuited field coil can generally be detected by the temperature it attains compared to the good coils, it remaining cool while the temperature of the others will increase. Where a volt-meter is at hand the drop of voltage across each coil is the most reliable test to make. In a 4-pole motor the drop of voltage across one coil should be very close to one-quarter of the voltage across the line. If the drop varies much from this, one may expect it to be defective. The decrease of voltage across the series field coils is very low, and unless a low reading meter is used and careful observations made the result obtained may be very deceptive.

FAILURE OF ARMATURE TO OPERATE

6:—Armature fails to start.

6 a:—Wrong connections, see Fig. 1 and Par. 1 h; also Fig. 2 where starting rheostat and motor are connected to one side of line only.

6 b:—Open circuit in rheostat or shunt field, see 1 g, 2 a and 2 b. A motor with this defect will start under light load when nearly full voltage is applied to armature causing vicious sparking.

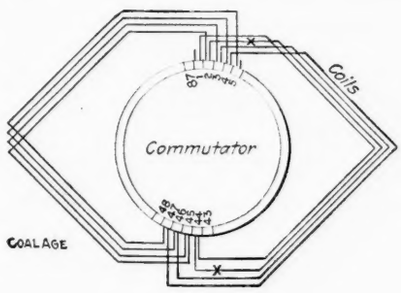


FIG. 10

6 c:—Tight bearings, armature down on poles, too much friction in line shafting or machinery driven, see 2 c.

6 d:—Wrong polarity, see 4 a and Fig. 5. The correct connection or polarity is shown in Fig. 3, and wrong polarity in Figs. 4 and 5. When coils are connected as in Fig. 5, armature will refuse to start.

6 e:—Short circuited armature. Only the test connections shown in Fig. 8 can be used to locate short circuit in commutator or in armature coils themselves. The trial is conducted the same as described in 1 e. When the defective coil is reached practically no hum will be heard on the receiver.

6 f:—Grounded armature, field coils or brush holder, see 1 d.

OTHER DEFECTS

Other defects that will develop from the too liberal use of oil are: commutators grounding, brush holders grounding, field coils grounding. If bearings are filled up too full the oil will run out at the ends and be drawn into the commutator or back end of coils, which will all sooner or later cause serious trouble.

Loose bolts should never be overlooked, bearings are many times battered out instead of worn out, poles get loose and come down onto the armature, causing burn-outs. Loose connection-bolts frequently cause trouble. Brush tension should be closely watched as serious sparking can frequently be cured by more tension. When replacing old worn-out brushes with new ones the tensions should be carefully adjusted. The distance that the brush holder is set from commutator should be watched; this distance should never exceed 3/8 in.

A neglected motor will, sooner or later, cause endless trouble and delay. No means is as sure to secure long and satisfactory service from one of these machines as eternal vigilance and attention to minutiæ. Probably no device for furnishing power exists which is as thoroughly dependable and reliable, day in and day out, rain or shine, as a properly constructed and properly cared for electric motor.

The Hoisting Engineer

I don't want to boast nor nuthin',
  But I've got this much to say:
If it wasn't for me that knows my biz
  There'd be much hell to pay—
For I lowers the miners and hoists 'em, too,
  Some several times a day.

A human life don't count for much
  When it's off in some foreign land:
But it means a lot when you're here on the hoist
  With that human life in your hand—
And multiply that by the number on shift
  And you'll see just how I stand.

A little mistake and they'd hit the sheaves,
  Or land in the watery sump;
Or spatter around on the plates and guides
  With nary a chance to jump—
But instead of that I lands 'em safe
  With scarcely a jolt or bump.

I drops the cage to a station floor
  So even and accurate, too,
That a car rolls on without a jolt
  The way it was meant to do.
And when she is loaded I hoists her up
  Like a limited train goes through!

Now I don't want to boast nor nuthin',
  But, as I began to say,
I reckon a job like mine is worth
  The price that the bosses pay—
For I hoists the miners and lowers 'em down
  Some several times a day.

—Berton Braley, in "Saturday Evening Post."

Gas Ignition by Electric Sparks

By W. M. Thornton*

A direct current will ignite gas at a much lower amperage than alternating current and is therefore in a manner less safe. A high frequency current requires a higher amperage than one of low frequency for gas ignition and to that extent may be regarded as more safe. As the electromotive force fluctuates in an alternating current, the duration of the spark is an important factor.

*Professor of electrical engineering, Armstrong College, Newcastle-upon-Tyne, England.

Note—Concluded from issues of Nov. 16 and Nov. 23.

My first tests of the readiness of gas to ignite from the sparks of alternating current were made at 40 periods with coal gas and air and with the same density of mixture (11 per cent.) throughout. To avoid disturbing effects, pure sine-wave forms were used. The currents required for ignition were all much greater than the direct currents at the same voltages, the ratios of alternating to direct current being as shown in Table I.

TABLE I.—RATIOS OF LEAST ALTERNATING TO LEAST DIRECT IGNITING CURRENTS. COAL-GAS AND AIR, 11 PER CENT.; 40 PERIODS, NON-INDUCTIVE CIRCUITS

Volts.....	50	100	200	300	400	500
Ratios A.C./D.C.	3.0	4.9	6.2	9.0	10.8	12.5

Alternating current may be much less likely to cause gas ignitions than direct, although when open sparking does occur the current is generally in excess of the minimum values found here.

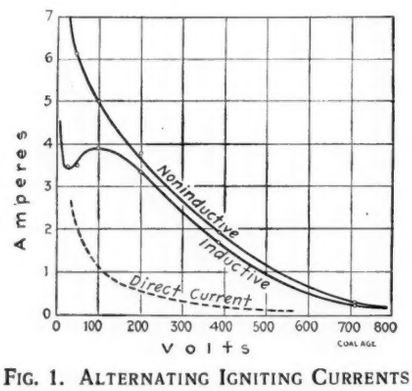


FIG. 1. ALTERNATING IGNITING CURRENTS FOR COAL GAS. FORTY PERIODS PER SECOND. IRON POLES

An interesting result followed the addition of small inductance (0.0025 henry) to the circuit. At the higher voltages, the least current which would ignite gas was perceptibly, but not greatly increased by inductance. At 200 volts, the difference due to inductance was greater although the ratios between alternating and direct current were much the same, but at 100 volts there was evidence of an unexpected drop. At 50 and 25 volts, the gas was more readily fired than at 100.

THE IRREGULARITY OF AMPERE-VOLT CURVES WITH ALTERNATING CURRENT

No variation in the conditions, such as polishing the poles or making fresh mixtures of gas and air, changed the result, the significance of which will be further discussed later. The flattened form of the curve suggests some instability similar to that familiar in the liquefaction of gases by compression, which is still more clearly brought out by the curves of Figs. 8 and 9.

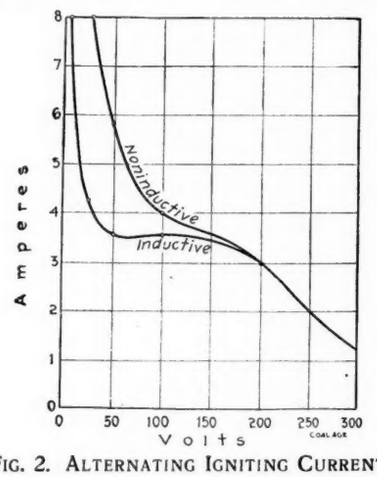


FIG. 2. ALTERNATING IGNITING CURRENTS FOR COAL GAS FORTY PERIODS PER SECOND. COPPER POLES

With copper rods, under the same conditions of frequency and density of mixture, the addition of the same inductance produced a similar divergence in the curves of Fig. 2 at about the same current, but both noninductive and inductive curves now show a flattening beginning at about 200 volts, as the voltage is lowered. Both curves are remarkably deflected between 50 and 100 volts, and again at the higher voltages.

There is clearly some critical condition introduced by the use of alternating current in all these cases, or rather a third factor of equal importance with voltage and current. The influence of inductance on the iron curve further suggested that time might be this factor, and that the shape of the curves might be greatly affected by the frequency of the current.

THE INFLUENCE OF MATERIAL OF TERMINALS

Frequency is not, however, the only important factor, for the currents in Figs. 1 and 2, although similar, are not identical and the difference is still further brought out in Fig. 3 for nickel poles. The least igniting currents here are less than for either iron or copper, and so differ from the results with direct voltages.

There is also in this case a remarkable sensitiveness to the composition of the gas. Curve A of Fig. 3 is for coal gas. Curve B, taken during the coal strike, when using gas largely composed of water gas, shows that in this case larger currents were required for ignition. The calorific value of the gas was little reduced, but the proportion of higher hydrocarbons no doubt was.

The currents with iron and copper poles were not affected by the change and one is led to suggest that the well known catalytic activity of nickel had some influence on the result. Despite the fact that carbon monoxide is reduced catalytically by nickel to methane, as demonstrated by Sabatier, and that, as will be shown, methane is readily ignited by arcs from nickel poles, the currents required were clearly in this case higher. The absence of higher hydrocarbons may, to some extent, explain the difference.

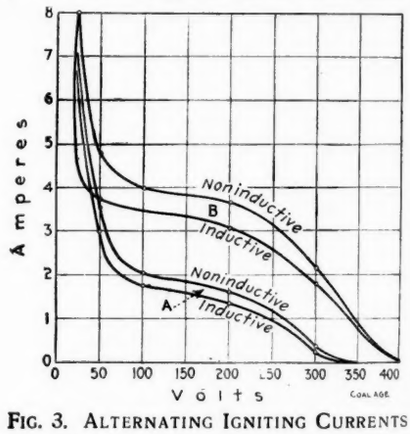


FIG. 3. ALTERNATING IGNITING CURRENTS FOR COAL GAS. FORTY PERIODS PER SECOND. NICKEL POLES. A, NORMAL GAS SUPPLY. B, WATER ADDED DURING COAL STRIKE

RAPIDLY DECREASING INFLUENCE OF PERCENTAGE ON BOTH SIDES OF A MAXIMUM

On the flat part of the curve of Fig. 3 the current is little affected by voltage. The portion between 120 and 200 volts was, therefore, suitable for the examination of the influence of change of percentage of gas with alternating current similar to the experiments made for direct currents. The results are given in

Fig. 4, and it is now seen that the characteristic flattening at the bottom of the curve obtained with direct current is nearly obliterated in the case of methane, and entirely so in coal gas.

This may be interpreted as showing that the time element is now predominant, and that it is the relation between the frequency of the current and the time of explosion which is here important. The curves of Fig. 4 approximate to parabolas, and that of coal-gas might well be taken for the "time of explosion" itself.

Before, however, examining the influence of frequency further, the trials were repeated in methane. The curves of Fig. 5 for this gas with iron poles are of the same type as those for copper and nickel

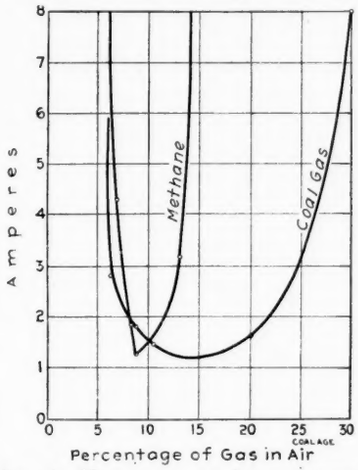


FIG. 4. VARIATION OF ALTERNATING IGNITING CURRENT WITH STRENGTH OF MIXTURE. NICKEL POLES. 200 VOLTS 40 PERIODS

poles in coal gas, but the flattening is prolonged to much higher voltage. The practical significance of this is shown by its influence on the ratio of the least igniting currents in methane and coal-gas, also given in Fig. 3.

With alternating currents at working frequencies, methane begins to be safer than coal gas at voltages above 200, the ratio rising to as much as 8 to 1 between 800 and 1000 volts.

COPPER POLES AT LOWER VOLTAGES SAFER THAN IRON

With copper poles (Fig. 6) and at low voltage, the currents are rather greater than with iron; at the higher voltages they are lower, but the curves are very similar in shape. The difference between these and nickel (Fig. 7) is remarkable. Both with coal gas and methane, the igniting currents are much lower with nickel than with iron or copper poles.

This is more clearly the case at voltages above 500, the point at which active ionization due to the high-voltage gradient across the incipient arc-gap is the controlling factor in starting ignition. The flat part continues to higher voltages in methane than in coal gas, as in the previous cases.

LEAST IGNITING CURRENTS AT VARIOUS FREQUENCIES

Good sine-wave forms were available from large machines at frequencies of 20, 40 and 80 periods a second and the various voltages were obtained by group-

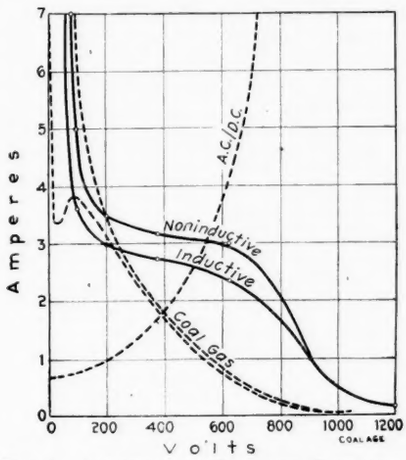


FIG. 5. ALTERNATING IGNITING CURRENTS FOR METHANE 9.36-PER CENT. MIXTURE. FORTY PERIODS PER SECOND. IRON POLES

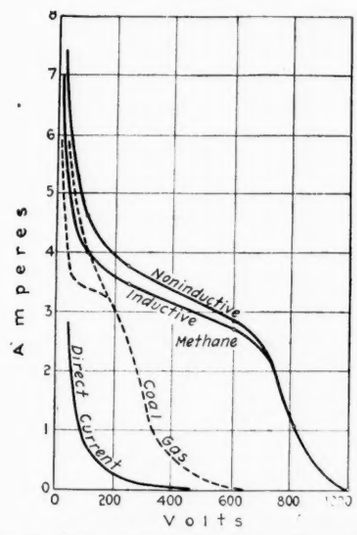


FIG. 6. ALTERNATING IGNITING CURRENTS FOR METHANE 9.36-PER CENT. MIXTURE. FORTY PERIODS PER SECOND. COPPER POLES

ing a series of 3- and 2½-kilowatt transformers as desired. The trials were made in 9.36-per cent. mixtures of methane and air, with small iron terminals and noninductive circuits throughout (Fig. 8).

TABLE II.—INFLUENCE OF FREQUENCY ON LEAST-IGNITION CURRENTS. METHANE, 9.36 PER CENT.: ATMOSPHERIC PRESSURE

Frequency	20	40	60	80
Volts	Amperes	Amperes	Amperes	Amperes
50	8.00	8.50		
100	3.80	5.00	14.0	15.00
200	3.00	3.50	12.0	14.00
400	2.20	3.25	6.5	11.50
600	0.70	3.00	5.0	9.60
800	0.35	2.00	4.0	8.00
1,000	0.25	0.40	0.3	5.75
1,200	0.20	0.25	0.2	1.40

The influence of increase of frequency in raising the least igniting current, when the frequeney is low, is marked: There appears to be a critical point between 40 and 50 periods and at about 100 volts. The figures are given in Table II for ready comparison.

WHEN THE SPARK IS BROKEN IT IS HARD TO RENEW IT

As previously mentioned, the initial period of induction always recorded in experiments on gaseous explosions provides an explanation of the influence of frequency of ignitions of the kind considered. The full "time" of explosion is rarely less than 0.05 sec., and the period of induction is generally of this order.

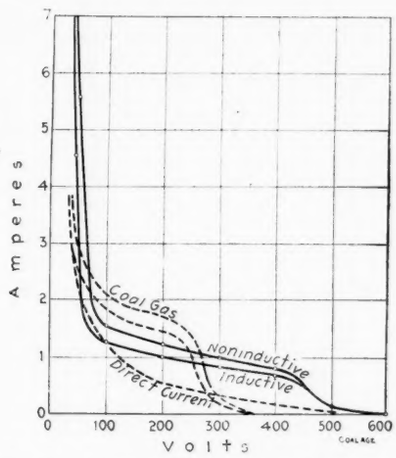


FIG. 7. ALTERNATING IGNITING CURRENTS FOR METHANE 9.36-PER CENT. MIXTURE. FORTY PFRIODS PER SECOND. NICKEL POLES

When the contacts are separated, the arc which is formed has to restart itself across the gap after passing through its zero value, and unless the air is being strongly ionized, a small gap suffices to prevent the arc from restarting. If the break begins when the current is just passing through zero value, there will be no arc at all; if at a crest or maximum value, the arc is greatest at the start, but is falling as the poles are separated; and, unless the initial current is sufficient to have strongly ionized the gap, the current on reaching zero will be unable to reform the arc in the opposite direction. The most favorable point in the cycle for the break to take place, in order that an arc should be formed with minimum energy, is on the rising side of the current wave.

It is evident that at the lowest circuit voltages, the current must be large in order to cause ignition by the liberation of a greater number of ions from the materials of the terminal. When, however, the maximum voltage gradient approaches 40,000 per cm. as it does on a 500-volt system at 0.017 cm. length of arc—that is, within a third of a period at a frequency of 40—the arc will be

maintained whatever the current may be, and small currents then ignite the gas.

At voltages between these limits of ionization by large currents on the one hand or high voltage on the other, the igniting current must be controlled by both; and since it has been shown that there is in the case of methane an evident relation between duration of arc and current required for ignition, the simplest expression taking account of duration and voltage is that the current is inversely proportional to the product of voltage and time of duration.

The Spark Duration is a Determining Factor in Alternating Currents

Fig. 9 has been drawn from the duration of sparks at different voltages, which I have determined, and it will be seen that there is a close similarity between the curve for nickel and that of the igniting currents. The curves for iron and copper are also of interest, showing as they do the dip observed first in Fig. 1 for iron, and to a less degree in Fig. 2 for copper.

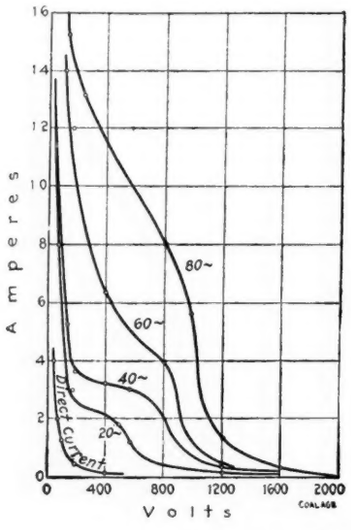


Fig. 8. Influence of Frequency on Igniting Current in 9.36-per cent. Mixture of Methane and Air. Iron Poles

The reason why this type of curve is not obtained from direct-current arcs is that voltage is there the controlling factor, as shown by the approximation of the direct-current curves to hyperbolas. The influence of the alternation of the current can, in fact, be regarded as that of a time filter or screen which retards the influence of voltage and brings out that of time of duration of the arc.

The influence of this is most noticeable in the case of nickel, which both in shape and relative position in the curves of Fig. 9 agrees in general with the experimental currents. The first approximation to the direct-current curves where I = current, V = voltage and S = duration of spark in seconds is, I varies as $\frac{1}{V}$ and to the alternating-current curves of Fig. 1 to 9, is I varies as $\frac{1}{VS}$.

The Higher the Frequency the More Characteristic the Curve

It is probable that the fact of alternation has less influence with longer periods of induction. This can, in fact, be shown experimentally by working with very dilute mixtures in which the time of explosion is much longer. Using a 6.5 per cent. mixture of coal gas and air, the curves of Fig. 10 were obtained, at frequencies of 40 to 80, and it is now seen that the lower-frequency curves are approaching the limit of the direct-current type, whilst the higher have all the characteristics of the alternating-current type under discussion.

It may be concluded that when the duration of an arc approaches the period of induction, in a gaseous mixture, ignition becomes increasingly difficult. All the foregoing results are for currents in circuits opened by a single clean break.

Influence of Physical Action in the Terminals

If explosive ignition is controlled by ionization in the immediate neighborhood of the spark, it should be influenced not only by the composition of the gas but also by the physical properties of the wires which affect the flow of either electrical or thermal energy to it.

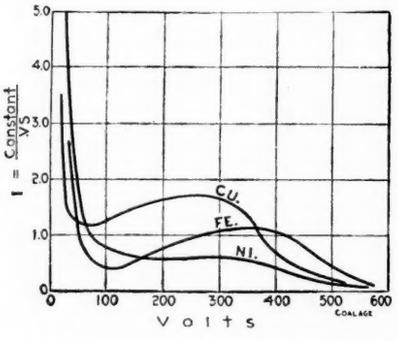


Fig. 9. Approximation to the Curves of Alternating Currents. Ordinates Inversely Proportional to Product of Voltage and Time of Duration of Arc

The three which may clearly have influence are the electrical and thermal conductivities and the melting point of the metal, for the exposure of fresh surface must depend upon the last. Regarding ionization as relatively proportional to the current passing in the spark, the least current should be directly proportional to the resistivity of the metal, for the flow to the surface exposed through the action of the arc must experience the same resistance as the normal steady current.

The extinguishing influence of cold metal surfaces on flame is well known. We may, then, as a first approximation take the required current to be directly proportional to thermal conductivity. In the same way the higher the melting point, the greater should be the current to expose the same area of fresh surface; and Wüllner and Lehmann's observation that ignitions occurred at the melting point indicates a close relationship between them. The products of these three are given in Table III.

TABLE III.—PHYSICAL CONSTANTS OF TERMINALS

Material	Resistivity, ρ	Thermal Conductivity, σ	Melting point, in deg. C. M	Melting point, in deg. C. $M\sigma\rho$	Ratios
Iron.....	19.9x10	0.115	1,505	344	2.16
Nickel....	11.8x10	0.142	1,435	241	1.51
Copper...	1.6x10	0.918	1,084	159	1.00

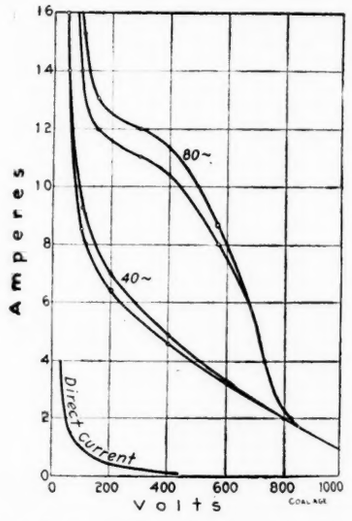


Fig. 10. Alternating Igniting Currents for a 6.5-per cent. Mixture of Coal Gas and Air. Forty and Eighty Periods. Iron Poles

A Rough Agreement Between Theory and Experiment

It will be seen that their order of magnitude is that of the positions of the curves for iron, nickel and copper when conducting direct current at medium voltage. In order to compare them more closely, it is necessary to find points on two curves the ordinates of which are proportional to two of these products, and to observe the position of the third.

The ratios of the three products for copper, nickel and iron are 1, 1.51 and 2.16, respectively. This is the sequence found in coal gas with direct currents, and the point where the ratio of copper to iron is 2.16 is at 60 volts. The ratio there

for nickel is 1.16, the currents being: copper, 0.8; nickel, 1.3; iron, 1.75 amperes.

This approximate numerical agreement can at the best be little more than accidental, considering the assumptions made; but that the order of the three metals is the same as above, points to a simple relation of the kind suggested. In the above, the diameter of the nickel rod was less than that of the others, although all were small; the current should, therefore, have been less rather than greater than the calculated value. The possibility of catalytic action has also to be considered.

Speed of Ionization

With regard to the gas, ignition is probably a question of intensity of ionization in the first place, and secondly of the speed of diffusion of ions into the gas. The difference between the ignition of coal gas and methane is no doubt partly caused by the presence of hydrogen in the former.

O. W. Richardson has shown that "the energy of the ions, both positive and negative, emitted by hot metals is the same as that of a molecule of gas at the temperature of the metal." In the case of the break-spark, the activity of ionization must be much more intense than this, in order that a volume sufficient to maintain self-ignition should be ignited by so small a source.

Ionization by alpha rays has been shown by Prof. Bragge to be greater in pentane and ethylene (constituents of coal gas) than in methane or air, and with alpha, beta and gamma rays it is from four to five times greater. This is in itself sufficient to account for the observed difference in sensitiveness to ignition of coal gas and methane by any means such as an electric spark, which gives rise to direct ionization.

For the same voltages, the ignition of gaseous mixtures by direct currents would appear to depend chiefly upon the material of the terminals, and ignition by alternating currents upon the nature of the gas.

Summary—The results group themselves under three heads. The first deals with the influence of direct-current break sparks on ignition; the second with the change in the least igniting current produced by altering the proportions of gas and air; the third with ignitions by alternating current, and the influence of frequency. The least igniting direct currents are roughly proportional to the reciprocal of the voltage.

Methane is not so readily ignited as coal gas in mixtures of the same percentage, but in the most explosive mixtures the difference is small. The igniting currents are found to be rising linear functions of the diameter of the rods, the rate of change with diameter being the same in each case. The energy of the least spark to ignite gas is found to be about 0.1 joule.

The time of duration of the spark at first increases, then decreases, and rises again with the voltage. The influence of varying the proportions of the gas and air is marked. The igniting currents for coal gas and methane have in each case the same type of transition, which can be accounted for by regarding the result as the combined effect of the "time of explosion" and the dilution of the explosive mixture by excess of either constituent.

There is a great difference between the least alternating and direct currents which will ignite gas, the former having much higher values and a remarkable curve of variation with voltage. This is shown to depend upon the frequency, period of induction, and voltage, ignition being much more difficult at the higher frequencies used.

It follows that the use of low-voltage alternating currents for signalling purposes gives a much greater margin of safety than is possible in direct-current working.

What Shall We Discuss?

Several months ago a discussion on "The Best Method of Attacking a Mine Fire" was started in Coal Age. During the weeks this question was debated, we printed 32 letters from experienced coal-mining men, and there is no doubt but that much light was thrown on this most important problem.

At the present time we are running a discussion relative to the question, "Should Mine Fans be Built Reversible." In our issue this week we print Letter No. 26, and there is still more to come.

The point is just this: These discussions have proved so interesting and instructive that we intend to continue them with greater frequency than heretofore, and we earnestly request that our readers write us stating their choice of a subject for open debate.

We want these suggestions at once—not in a week or a month—and we will send our check for $3 to that subscriber who first mentions the subject we select next for discussion. All letters will be numbered in the order of their receipt, and the subject most favored by our readers will be chosen first. The question ranking second in popular request will be brought up for debate later.

The name of the person making the successful suggestion will be published, unless we are requested to withhold this information.

Protection of Mining Machine Cables and the Men Handling Them

By Edward J. McTigue*

Nearly all electrical mining and drilling machines, when shipped from the factory, are well protected with fuses or one of the numerous types of circuit-interrupting devices which break the current at the machine in case of overloads or short-circuits. While this gives protection to the machine if maintained in proper working order, it affords none whatever to the supply cable or the men who have to handle it.

A short-circuit in the cable between the machine and the feederline invariably results in its being either severely damaged or entirely destroyed, due to the large amount of current which then passes it, burning the insulation and in some cases fusing together the wires of which it is made up.

This class of electrical cables are subjected to severe usage and short-circuits are unavoidably of frequent occurrence. The results are heavy bills for renewals which form a large item in the maintenance cost of all mines using this type of mining and drilling machines.

Cases are numerous, also, where the men handling mining-machine cables have been seriously burned by such short-circuits occurring while they were thus engaged.

This Danger Can Be Eliminated

This trouble can be entirely overcome by placing a fuse, with a current-carrying capacity 50 per cent. greater than that normal to the machine, on the cable at the point where it taps onto the feeder line. This will protect the cable as well as the men handling it and will isolate this conductor from the rest of the feeder system in case of trouble.

A fuse, placed as above, will reduce the possibility of fires and explosions caused from the arcing which always takes place on nonprotected cables when a short-circuit occurs.

Employers' Liability and Workmen's Compensation

Our second article on *Compensation* and *Liability* laws has been held over until next week, due to lack of space for general matter in this electrical issue.

It has been suggested that it would be a good plan for the United States Geological Survey to complete its classification of the different varieties of coal by correlating the seams of the various states, which at present have different names in each state.

*Chief electrician, Ebensburg Coal Co., Colver, Penn.

Who's Who—in Coal Mining

Devoted to Brief Sketches of Prominent Men, Their Work and Ideas

In the British Isles is a lively organization known as the Association of Mining Electrical Engineers, which is so large that it has organized branches to facilitate the meeting of its members. I call attention to this fact, because in the United States mining electrical engineers are few and far between We have usually either left the care of matters electrical to a handy man of all work or we have put it in charge of a mechanical engineer.

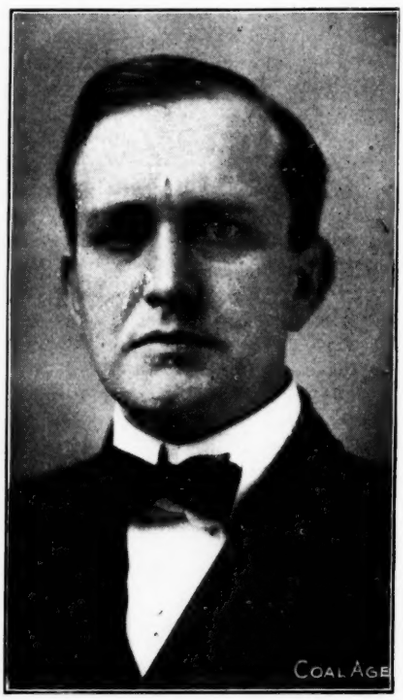
It is interesting to note that the virile body of electrical experts, just mentioned, did not come into existence because there was no combined mining and mechanical engineering institute in which electricians could enter as is the case in America. It arose simply because the electrification of collieries was one of the predominant facts of modern mining.

I mention this, before introducing J. T. Jennings, the chief electrical engineer of the Philadelphia & Reading Coal & Iron Co., because we are still wondering why electrical engineers are to be found at some plants and whether they are really needed at others. The need of electrical engineers is not duly felt. We do not realize that we need them because we get along with antiquated equipment. Not that the electrical companies are unable and unwilling to put us in the forefront of progress and economy, but because our mechanical engineers, or with small concerns, our general managers, are afraid and rightly afraid to install machinery of which they know nothing.

J. T. Jennings was born 37 years ago, of British mining stock, in the city of Scranton. He was one of six sons, four of whom still have remained true to the coal-mining profession and are prominently connected with large coal companies in the anthracite fields.

He started his electrical work under Col. W. A. May, the veteran manager of the Erie operations. Here he remained two years getting an insight into mining practice. There are a number of people who hope to get the qualifications of an electrical engineer by what they falsely term practical experience. Others there are who hope to get the requisite knowledge from books.

Mr. Jennings was not attracted by either method as a final resort. He preferred to go to the General Electric Co. and to learn there how to manufacture the machinery and instruments which he expected to handle. He served four years in the shops and electrical departments,



J. T. JENNINGS

three years of which were at Schenectady and one at Lynn, Mass. After leaving the General Electric Co. he returned to the Erie operations, where he remained for two years. He then left to accept the position of electrical engineer with the Davis Coal & Coke Co., in West Virginia.

Not only competent but friendly, as willing to impart information to his subordinates as he had been ready to absorb it from his instructors, J. T. Jennings soon made a change in the conditions at the Davis power plants and brought the operations up to a high electrical standard. After two years Mr. Jennings was put in charge of both departments of the coal company and carried both titles on his still youthful shoulders.

It is not generally known that J. T. Jennings was seriously considered for the position of superintendent of mines, but his youthful appearance defeated him. He had the nickname of the "Young Engineer," and had it not been for his youthful appearance it is certain that a good electrical expert would have been spoiled to make a mining superintendent.

While with the Davis Coal & Coke Co. he doubled the capacity of the Thomas plant and designed and installed the electrical equipment of the Coketon and Henry Collieries. And it was during his stay in West Virginia that Mr. Jennings invented the combination lag-screw trolley-wire hanger, interchangeable for rock and timber. The hanger is extensively used in mine-trolley construction today, and both the General Electric Co. and the Ohio Brass Co. are using the device He also initiated the tandem electric locomotive system of hauling coal, thus reducing the labor cost of transportation 50 per cent. over heavy grades.

In 1904 he left the Davis company to accept the position of electrical engineer with the Philadelphia & Reading Coal & Iron Co. At that time this concern had no electrical machinery in operation. Since then 30 per cent. of its collieries are equipped with electricity, which is used for hoisting, haulage, pumping, ventilating, stationary-motor work and lighting.

Mr. Jennings is an enthusiast in his work. If it had not appealed to him forcibly, he would never have entered the profession; for at the time when he left the Erie there were permanently employed around the coal mines, or engaged in a consulting capacity, no electrical engineers earning large salaries, or enjoying the approval of the public.

The electric current and its use, development and control were the ends he sought. Whether a knowledge of electrical science would bring money and position, he did not know. His interest was not in his "career," but in the ends to be achieved. He was an enthusiast then, and the interest he had in his profession has never waned.

He delights in doing the type of work which endures. Slipshod construction he does not favor. It is better to avoid any construction which is not reliable. The loss of time, the expensive expedients resulting from a breakdown, make scamped work costly and exasperating.

He sees that all machinery is kept in good order, and if anything is wrong, he knows what is needed. It is a stock joke about the mines to say of a clever repairman that he understands the machine like the man who made it. But it is no joke with Mr. Jennings. He may not have made that particular machinery, the repair or operation of which he is directing, but he has made many devices similar to it—the forebears, so to speak, of the machine under consideration.

He has worked for a long time and with success on the design of a lamp to be worn in the caps of working miners.

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This journal is interested solely in matters relating to the fuel industries, and is designed to be a medium for the free interchange of ideas, the detailed description of coal-mining practice, and the expression of independent thought calculated to benefit both operator and miner.

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COAL AGE

Ignition of Gas By Sparks

The tendency in America has been to use direct current at the face in mining work, whereas the European custom is to use alternating current for almost all purposes. Consequently the investigations of W. M. Thornton in England, which tend to show the superior safety of alternating currents in the presence of gas, are of extreme interest.

For instance, a non-inductive iron circuit of 240 volts, direct current, will ignite a 9.36 methane mixture when the amperage is only 0.40. But if alternating current is used at a frequency of 20 periods per second, the least igniting current is about 2.8 amperes. Raising the frequency rapidly increases the safety, the least igniting current being about 4.7 amperes at a frequency of 40, 10.9 at a frequency of 60, and 13.5 at a frequency of 80.

The curves accompanying Dr. Thornton's article indicate that with percentages of methane lower than those which give the most complete combustion, somewhat larger currents may be used with safety. Especially will that be found true in all probability near the lower limit of explosibility, viz., 4.25 per cent. Moreover, a further safety can be obtained where copper is used.

But it is clear that only trifling currents like those used for signaling purposes could be kept within the limits of safety. Consequently, while we are probably justified in saying that alternating current is safer than direct, it is equally clear that motors and electric mining machines cannot be safely used in a gaseous atmosphere unless guarded by protective devices, whether they be actuated by alternating currents of high frequency or direct current. It is for this reason that we welcome what light has been thrown on these devices by the Bureau of Mines.

It is interesting to note that with a low voltage, a large current is needed to ignite gas. On the other hand, no matter how much we reduce the current, there is always a voltage which will explode the gas mixture. This seems to be true both of alternating and direct current, for the voltage is the leading characteristic.

The experiments bring out clearly the importance of the inductance of the current. It is true that a direct current traveling in a circuit however full of solenoids does not have any inductance while the current is unbroken. As soon, however, as the circuit is severed, the current drop takes place, and the magnetic lines of force formed by that drop induce a current in the original direction and the duration of the spark resulting from severance is extended. This is why a simple circuit is more likely to cause a gas ignition than one which has coils.

The duration of a spark in a non-inductive circuit seems to have a maximum for each different metal. Thus the spark of a copper terminal seems longest at 50 volts, whereas iron and nickel terminals give the most lasting spark when the electric pressure is 100 volts.

When less voltages than these figures are being used, the currents needed for ignition rapidly increase, because the duration of the spark speedily decreases and its energy has to be augmented by greater current strength.

Remedies For Electrical Troubles

The failure of even some of the smaller pieces of electrical apparatus about a coal mine may entail serious losses. Generally speaking, such contingencies may be foreseen, and if the proper steps be taken, the moment of absolute refusal to operate may be delayed until permanent repairs can be made.

On another page of this issue there appears an article entitled "Remedies for Electrical Troubles," which covers the emergency cure for most of the ailments to which small direct-current motors and generators are subject. So thorough and concise is this short treatise that we believe it might better be studied than hastily read by all who are in any way responsible for the successful operation of this class of machinery.

Carbo-Electric Conversion

The expression, carbo-electric conversion, has been coined to visualize an industry which is as yet hardly in existence in America, but which in the future will absorb the greater part of the activities of the coal field. The large installation now being erected at Hauto by the Lehigh Coal & Navigation Co., represents a condition which is exceptional and can hardly be considered as showing the trend of present thought.

We are hearing much about hydro-electric conversion, but it hardly arouses more than passing interest among coal men. Competition with gas, oil and water power has existed for so long and has injured the coal business so little that the scheme by which the potential energy of water is turned into electricity for transmission does not fill the coal operator with disagreeable portents.

But it is time that the managers of the coal mines consider the importance of certain hydro-electric plants which are being built or at least projected in the heart of the coal fields, in places where carbo-electric plants could well take their places.

Among other instances, on the New River, the Appalachian Power Co. has two dams under construction which are to supply electrical energy not only to Roanoke and Saltsville, Va., and to Bluefield, W. Va., but even in the heart of the coal regions at Pocahontas, Welch and Coalwood, W. Va., passing the large number of prosperous coal operations which line either bank of the Elkhorn and Tug Rivers.

The operators whose slack coal is, for many months in the year, a drug on the market should not overlook this tempting source of profit. Around many mining plants, electric street cars, power and lighting plants are found in operation. Many of these buy run-of-mine coal, which is shipped to them by railroad at a comparatively high freight. The cost of the freightage could be eliminated and the coal used could be slack of merely nominal value if a central power station were established at the mines.

The cry of the villages of the coal fields that fuel is cheap near the mines is only relatively true. The cost of power and of heat in the coal regions should be so low that all other centers of industry should be neglected except those which have water power. Only those manufactories utilizing materials foreign to the coal regions and too bulky for ready transportation, or making fabrics too delicate to endure the smoke of the coal districts, should be located beyond the power radius of the coal mines.

The operators have taken an unbusinesslike stand. The markets have demanded large coal of pure quality and the salesman has been content to supply what was wanted. There has been little desire to induce the customer to take what he did not demand and the result has been that the operator has had to give away his slack and thus abandon an important source of profit.

The mine owner should have taken an interest in the burning of smaller grades. He should have aided exhibitions of slack-burning grates and furnaces. He should have backed the Bureau of Mines in its investigations instead of regarding the combustion of coal as no concern of his. But he should have concerned himself even more with the possibility of using the slack himself, thus securing not merely the price of lump coal for his inferior sizes, but also a large part of the cost of freight formerly paid by the customer.

It is strange that a Nova Scotian has exhibited to us in America the better method. We have known it for years and might have followed it. But when it rained, it was too wet to fix the roof; when it was fine the repair was not needed. When the prices of coal sunk, so that the operator lost money, he could not afford to install a central power station. When trade flourished, he was making so much money he must fain buy more mines. So it has continued; good times made him spread his operations and when the rainy day occurred, he did well to keep what mines he had from the ever-present sheriff.

It is to be hoped that now business is brisk, the operators will learn intensive operation and not seek such an extension of their interests that every new development will starve for want of pecuniary fostering. But today when most operators are looking for promising investments in backward states, it would be well for them to remember that the chances to sell power are brightest in those commonwealths which have long been developed.

The salesman of a coal corporation should have two objects instilled into him, the first to induce the coal consumer to move where he can get coal or power without paying tribute to the railroad, and second to convince him that if he will not move his place of business, he will do well to put moving grates and mechanical stokers in place of his handfed outfit.

Our methods today furnish a brilliant example of how work ought not to be done. The assertion of Brandeis that the railroads are losing a million dollars a day is spectacular in the extreme, but we hesitate to deny that the stated inefficiency is not duplicated at our coal mines. Perhaps if the ground is looked over with care, by eliminating the services of the railroads, we may effect an economy almost equal to that which Brandeis has indicated.

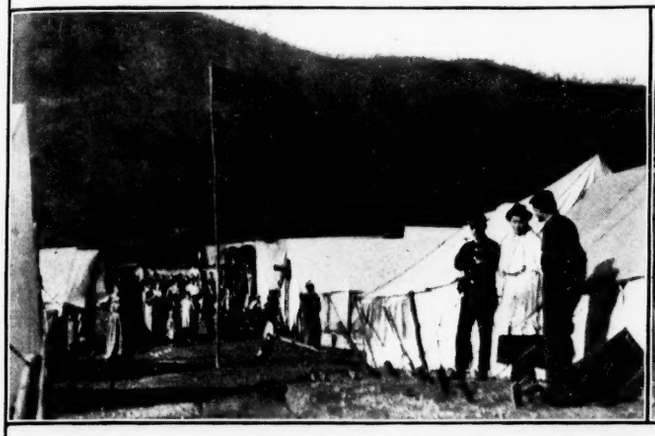
It is true that legislation has hampered proper development, because we have zealously restrained all corporations from engaging in omnibus operations, either by actual legislation or by narrowing the terms of recent charters. We have even prevented breweries in some states from selling surplus ice.

How much we could learn from Belgium, for instance, where a company has just been formed for the purpose of coking coal, selling the product and the by-product, turning some of the waste heat into power, converting the power into electricity for sale and for the operation under company control of docks at Gand. We do not, of course, suppose this is a solitary instance, nor that such enterprise and broad incorporating powers are by any means, confined to Belgium.

In the State of Victoria, a firm has been organized to mine brown coal, convert it into power and to transmit electrical energy to Melbourne. Of course, a company could do this in almost any state in this confederation, but it would not be allowed, at least in most states, to sell the coal mined under the same charter under which it sold power and light.

The world moves. When we passed our restrictive legislation, no coal company made power for itself and electricity was not transmitted. The electorate only intended to prevent companies from engaging in enterprises which were not incidental to mining. It is time that legislation took cognizance of new needs and it is the duty of operators to see that the powers so sorely needed by consumers and operators alike, are granted by the legislatures of every state.

Scenes from West Virginia Strike

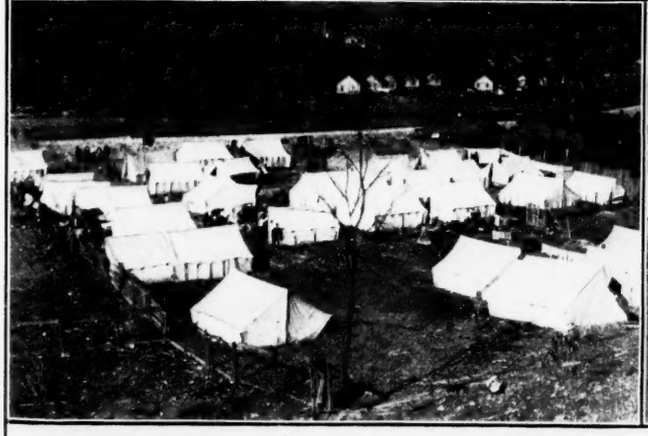


Striking Miners Tenting in the Fields Along Paint Creek

Militiamen Preparing to Clear Railroad Tracks

Strikers in a Tented Town Supplied by the Miners' Union

A Cabin Creek Riflewoman on Guard Before Her Tent



A Town of Tents With the Vacated Village in the Distance

Gen. Elliott and a Group of Eskdale Workingmen

Discussion by Readers

Comment, Criticism and Debate upon Previous Articles, and Letters from Practical Men

Should Mine Fans be Built Reversible

Letter No. 25—Every mine manager and employer of labor will agree with me that the use of alcoholic stimulants, even in a moderate way, is detrimental to good company work; but they will be equally willing to admit that there are times when the proper use of the same alcoholic stimulants is most beneficial and, perhaps, may be considered a life saver. The question whether a mine fan should be built reversible or not seems to me to be in the same catagory with the above.

It is my opinion, based upon practical experience and personal observation, that the flow of air through a mine, caused by a ventilating fan, should never be reversed, in the general operation of the mine; and that, even in case of accident, the air current should not be meddled with or reversed, except after careful consideration by the officials in charge. However, there *are* times when the reversal of the air current may mean the saving of a life or lives.

Such a case was brought to our attention by E. H. Weitzel, manager of the Colorado Fuel & Iron Co., Letter No. 16, Nov. 16, p. 691. I am personally aquainted with the facts in that case. The question is therefore a proper one: Should we condemn a thoroughly satisfactory mechanical design and installation, because of the possible incompetency or ignorance of the officials in charge? There is absolutely no reason for reversing a mine fan without good and sufficient cause, simply because of the fact that it has been built to be operated in either direction.

F. P. BAYLES, Supt.
Carbon Coal & Coke Co.
Cokedale, Colo.

Letter No. 26—I have followed with much interest the discussion in COAL AGE, on reversible fans. Letter No. 16, p. 691, Nov. 16 gives two instances, occurring within a brief period of time, when the reversible fan was the means of saving both life and property. Letter No. 13, p. 653, Nov. 9, also cites two other occurrences that illustrate the value of the reversible fan. Letter No. 15, p. 691, Nov. 16, however, regards the reversible fan as a menace to safety, and this in face of recorded facts that have shown where the reversible fan has been the means of saving both life and property.

Although the writer last mentioned admits that theoretically the reversible fan is a good safeguard, he states that he never had occasion to reverse the fans that he had installed; and, calling to mind where some men have used poor judgment in reversing the fan, he feels justified in pronouncing the reversible fan a "menace to safety." He speaks of eliminating the "if," but he must admit that there are instances where *if* the fan had not been reversed life and property would have been lost.

An incident that happened at the Weaver Mine of the Victor-American Fuel Co., at Gibson, N. M., Dec. 1909, will illustrate my point. No. 1 Weaver had been abandoned and No. 2 Weaver was being ventilated by the No. 1 fan. A fire started about 10 a. m., in the old No. 1 mine, close to the intake air-course of No. 2 mine. It proved to be a very stubborn fire to fight.

The mine was working two veins, with only 6 ft. of strata between them; and, at the point where the fire started, the roof had fallen to the upper vein and this fall was heavily timbered. The fan was producing 75,000 cu. ft. of air per minute, which rapidly carried the fire onto the air-course. At the point where the roof had fallen, the coal and timbers were quickly ignited. The superintendent and foreman were both in the mine at the time, but were not aware of the fire until the smoke reached the 3rd. right workings. They at once gave instructions to get all the men out of the mine as quickly as possible, at the same time notifying the general superintendent of the trouble.

The three officials, after a brief consultation, decided to at once reverse the fan. There were 250 men in the mine at the time, and a large number of these had already been overcome by the gases and smoke that reached them from the fire before the fan was reversed. The results showed later that this prompt reversing of the fan was the means of saving the lives of many men.

I frankly admit that there are conditions that must be carefully considered before reversing the fan, but these should be discussed when everything is in good shape. If mistakes are made by reversing the fan when it should not have been reversed, the responsible party and not the fan should be criticised.

D. H. SOMERVILLE, Supt.,
The Victor-American Fuel Co.
Gibson, N. M.

Bituminous Coal Mine Reports

Referring to the article, "Bituminous Coal-Mine Reports," COAL AGE, Nov. 9, p. 639, in which reference is made to the reports of mine foremen under the Act of June 9, 1911, and firebosses under the Act of May 15, 1893, permit me to state in connection with this matter that, after the passage of the Act of June 9, 1911, the chief of the Department of Mines prepared and had printed books for the use of the mine foremen and the assistant mine foremen in making their reports of the conditions found in the mine when making their daily tour of inspection or the inspection after each shift.

These blankbooks were arranged according to the new law, which requires the mine foremen to make a daily record of the condition of the mine as to health and safety, and a weekly record regarding the quantity of air in circulation, and the assistant mine foreman to make a record at the end of each shift as to the safety of the working places visited by him. The books were sent to the mine inspector, for distribution to all mines; and the inspectors were instructed to impress upon the mine officials the necessity for keeping the records in accordance with the requirements of the law. These books are kept in the mine office, at the mine, for examination by the inspector and by any person working in the mine, such inspection to be made in the presence of the mine foreman.

It would seem from the article to which I have referred that these books had been prepared by the mine inspectors, which is not the case. They were prepared by the chief of the Department of Mines, in accordance with the requirements of the Act of June 9, 1911, and sent to the inspectors for distribution, as stated.

The book for recording the reports of the firebosses, also prepared by the chief of the Department of Mines, under the Act of 1893, will soon be superseded by a new form, which is now in preparation. We appreciate very much the publicity you have given this important work of the mine officials; and it is a matter of satisfaction to the department to be able to state that the uniformity so much desired in these reports has, to a great degree, been attained.

FRANK HALL, Deputy,
Department of Mines
Harrisburg, Penn.

Carbon Monoxide and the Safety Lamp

I was interested in the question asked by Fireboss, COAL AGE, Oct. 12, p. 510, and the answer there given. The question was as follows:

> Please describe the nature of flame and explain why a lamp flame will burn more brightly when carbon monoxide is present in the atmosphere.

You answer this question by giving an illustration that explains the action of flame in the presence of carbon monoxide. This answer I consider good authority on a subject of this kind. However, Technical Paper No. 11, issued by the Bureau of Mines, and written by George A. Burrell, p. 4, states as follows:

> The author is aware that some mining men are of the opinion that a percentage of carbon monoxide below that which is immediately dangerous, perceptibly brightens or lengthens the flame of a lamp, but he knows of no characteristic of carbon monoxide that would warrant such an opinion.

The paper then gives a possible explanation of the brightening or the lengthening of the flame, suggested by J. W. Paul, mining engineer of the bureau.

The answer given in COAL AGE and the remarks in Mr. Burrell's paper are so much at variance that an explanation is due. Confusion of this kind, coming from men who are known to be authorities, places students preparing for examination, in an uncertain position.

To answer the question acceptably, the student would have to be acquainted with the preference of the board of examiners; and know whether they took the bulletins issued by the Bureau of Mines as authority, or whether they considered correct the answer usually given in our mining textbooks and the explanation in COAL AGE.

My own experience has taught me that carbon monoxide is the most dangerous gas to be found in coal mines; that it is not easily detected, and that men become sick and are often overcome and do not know the cause. We had an instance of this here in Illinois some time ago. Three men went into a mine as a rescue corps, after the occurrence of a severe explosion, in which a number of lives were lost. The three men provided themselves with safety lamps; and in their anxiety to find if any men were still alive in the mine, they passed beyond the last open crosscut and ahead of the air A little later another rescue corps was organized to go in search of the first party. They were careful, however, not to get ahead of the air. The bodies of the three men were found where they had fallen, and their lamps were still burning.

This experience taught me that it was not safe to explore a mine and depend upon the safety lamp, because it continues to burn in an atmosphere fatal to life. It is well known that the lamp will burn in a percentage of carbon-monoxide gas that is fatal to breathe. The paper issued by the Bureau of Mines is ably written and is replete with information regarding the detection of carbon-monoxide gas. Inasmuch as the answers are so much at variance, I would be pleased to have the results of tests made by mining engineers who have laboratories and can give the percentage of carbon-monoxide gas that can be detected by the flame of the lamp.

J. D.

Peoria, Ill.

[It will be remembered by readers of COAL AGE that this same question was raised by one of our correspondents and answered Apr. 27, p. 953. The question asked, at that time, by correspondent, was in relation to the answer given to an examination question, in COAL AGE, Mar. 9, p. 720. The question read as follows:

> Describe the action of the different gases on the flame of a safety lamp.

In speaking of carbon-monoxide gas, in answer to this question, the usual lengthening and brightening of the flame were described briefly, and it was stated "the cap formed by this gas is not clearly visible." The answer stated, further, "However, it is unsafe to rely wholly on these indications for its detection. Other means should be used, as the blood test or the canary or mouse test."

In this connection, we desire to refer our readers, again, to the explanation of the effect of carbon monoxide on flame, as given on p. 953, Apr. 27; and to the further explanation of the brightening of the flame when this gas, or fine coal dust, is present in the atmosphere, as given on p. 510, Oct. 12, to which our correspondent now refers.

We do not wish to criticize Mr. Burrell's paper, issued by the Bureau of Mines. In most respects, the statements it contains are correct, and we consider the paper a valuable addition to mining knowledge. There is seldom a paper written that deals in valuable details and is progressive that cannot be justly criticized in one respect or another. If this were not true, there would be no value in discussion.

The subject of mine gases is one that we are all studying with deep interest. Referring to Mr. Burrell's paper, Mr. Dunlop considers it at variance with our explanation on p. 510. The two points in question are: (1) The statement of Mr. Burrell that "some mining men are of the opinion that a percentage of carbon monoxide below that which is immediately dangerous, perceptibly brightens or lengthens the flame of a lamp, but he knows of no characteristic of carbon monoxide that would warrant such an opinion." (2) The suggested possible explanation of the cause of the brightening of the flame due to "a larger proportion of oxygen in the air, etc."

We think the statement errs in assuming that "mining men" or textbooks have ever thought or claimed that the flame test was a reliable means of detection for carbon monoxide; although there is hardly any question or doubt but that this gas both brightens and lengthens the flame of a lamp, as explained in all textbooks, and that this effect is produced, in degree, by very small percentages of the gas. Attention, however, has been repeatedly drawn to the fact that it is never safe to rely on the flame test for carbon monoxide, but that the mouse test or blood test should be used always when entering a place where carbon monoxide is expected or may be found.

In regard to the second point, namely, the suggestion that the increased brightness of the flame is due to entering a place in which the proportion of oxygen in the air is larger than it was in the place previously explored, causing the wick flame to burn, for a while, with increased intensity. The paper states correctly that "as the oxygen content of an atmosphere decreases, the flame of an oil lamp burns more dimly until, at 17 or 17.5 per cent. of oxygen, the flame is extinguished." Again, the paper states ". . . . . carbon monoxide, in quantity sufficient to produce a cap, usually accompanies a deficiency of oxygen and an excess of nitrogen, so that the lamp is extinguished before it can show a cap."

It is difficult to understand, in comparing these two statements, how a deficiency of oxygen accompanies the presence of carbon monoxide, and yet the increase of oxygen is offered as an explanation of increased brightness of the flame. Certainly, men of experience in mines know when they are entering fresher air, and would not mistake the increased brightness, at such time, as an indication of an unsafe atmosphere. Also, it is difficult to understand the suggested extinction of the lamp before the cap appears on the flame, and the statement that a sufficient quantity of gas is present to produce a cap. These statements are incongruous, to say the least.

We do not believe the old mining textbooks are inspired; but, on the other hand, accepted statements should not be set aside hastily without sufficient proof that they are in error.

Much of the work of the Bureau of Mines is necessarily progressive, in which fact lies its value. It is the province of the technical press to discuss suggested explanations and theories and voice the opinions of their contributors. In the meantime, let examining boards and candidates preparing for examination follow the well beaten paths, in preference to accepting untried statements.

Sociological Department

For the Betterment of Living Conditions in Mining Communities

The Motor Car in Rescue Station Work

SPECIAL CORRESPONDENCE

In Great Britain the practice has been adopted of establishing in a district where there is a group of collieries, a central rescue station, from which the rescue brigade and necessary apparatus can be transported to any required scene of operation within its effective range. A considerable amount of ingenuity has been expended in the proper equipment of such rescue stations, both for the purposes of training and also for their effective operation in times of accident.

A Motor Car Can Be Made to Carry Sufficient Men and Equipment

One of the most important problems in connection with such work is the quick transport of the men and materials to the actual shaft where an accident has occurred. In some cases the local railways are made to serve a very good purpose in this respect, but a system of much greater flexibility is necessary if a rescue station is to obtain its maximum degree of usefulness.

For this reason the gasoline motor car has come into use, and the illustrations show a type of equipment which has been adopted in the Aberaman and Rhymney Valley rescue centers. Both these cars were built by the Lacre Motor Car Co., Ltd., of London, and the chassis of both are of the standard two-ton type, fitted with 38-hp. engines.

These vehicles can each accommodate 11 men forming the rescue brigade, and have separate compartments for 11 sets of Draeger breathing outfits, four oxygen cylinders, four pulmotors, or automatic breathing apparatus, an ambulance kit and tools.

Fig. 1 shows the external appearance of the Aberaman car, while Fig. 3 illustrates on the Rhymney car, the location of the stowage space for the various portions of the outfit. The great degree of compactness which has been obtained is at once apparent.

Fig. 2 shows the same car with the outer doors opened so as to afford easy and immediate access to the equipment carried. The cars are also fitted with a well, which is accessible from the interior by four hinged doors in the floor and this well contains potash cartridges and hand lamps. At the side of the driver's seat there is an arrangement for carrying the pump and two fire extinguishers.

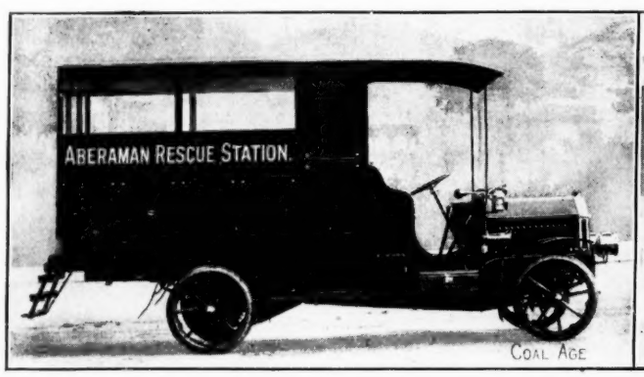


FIG. 1. RESCUE MOTOR CAR OF THE ABERAMAN STATION

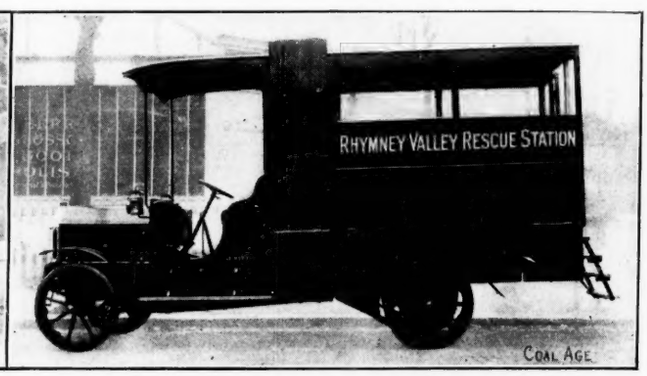


FIG. 2. CAR OF THE RHYMNEY VALLEY STATION WITH SIDE DOORS OPEN

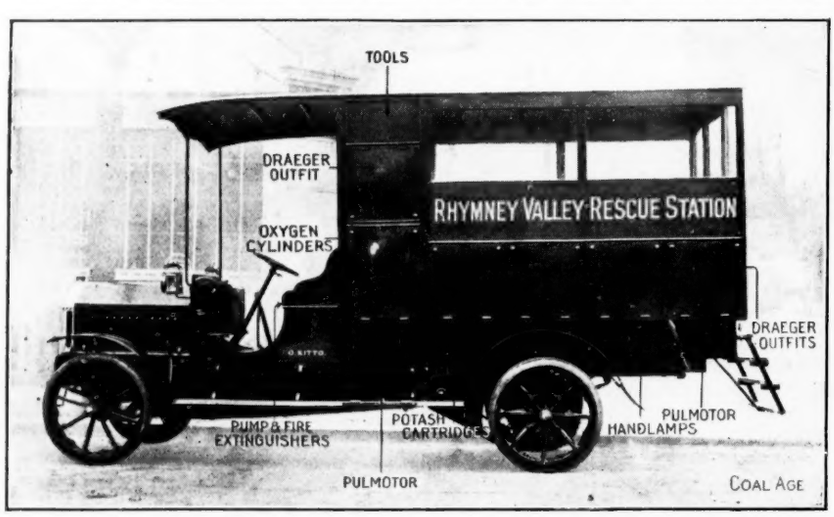


FIG. 3. RHYMNEY VALLEY RESCUE STATION MOTOR CAR SHOWING LOCATION OF EQUIPMENT

Hookworm Disease

J. W. Pryor, professor of anatomy and physiology in the Kentucky State University, has been greatly interested in the question of hookworm disease and will give a paper on this subject as it applies to miners at the forthcoming meeting of the Kentucky Mining Institute. He will show how easily the local doctor can detect the disease and how he can cure it; also what the operator should do to prevent its existence in his camp.

Dr. Pryor has slides which he will use at the meeting and will have the hookworm ova (eggs) and worms exhibited under several microscopes. This is the manner of diagnosing this disease.

It would be profitable for the coal companies to send their doctors to this meeting in order to enable them to become perfectly familiar with a disease which is easily controlled.

A New Electric Lamp

By David J. Griffiths*

Even under every favoring condition, coal mining is dangerous, and inefficient illumination is one of the important factors adding to its risks. The ordinary miners' oil lamp gives a poor light, under the most advantageous circumstances, and in a wind or where the air is befouled, the illumination it affords is wholly inadequate.

The Open Light is Troublesome and Insufficient

Moreover, the miners' torch lamp demands considerable attention, the wick often needing to be trimmed and pulled up and the reservoir requiring replenishment. The methods by which a lamp is kept burning at its best are not understood by the green hand, and even when every care is taken, the lamp does not show a sufficient light for examining the roof or the coal with the result that, on the one hand, accidents and deaths and, on the other, dirty coal are chargeable to the insufficient light afforded.

When timbering, the oil lamp is most inefficient, especially when cribbing on the top of a 3-set piece, to a height of 20 to 25 ft. If water happens to drip from the roof, the conditions are worse. In driving mules, the demand for the electric light is imperative both on account of the need of penetrating the darkness well in advance, when traveling at speed and because the wind resulting from the rapid progress reduces the intensity of an open light so that it is of little value.

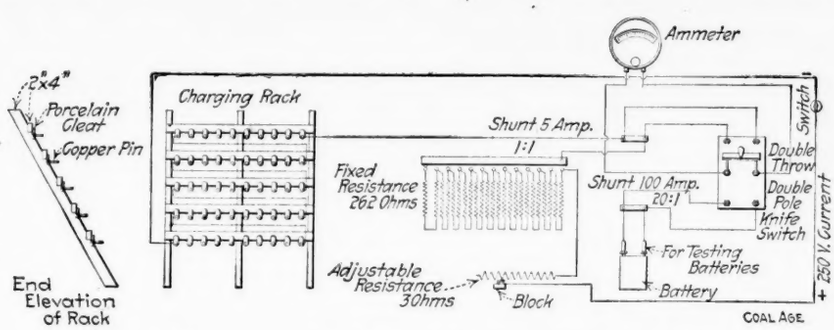
The Open Light is Dangerous and Insanitary

In the West, another disadvantage is that an open lamp is apt to set fire to brattices and brattice cloths with unfortunate results to life and property. And in all gaseous mines, an open light is not safe. In many mines, unprotected lamps have been retained because of the prejudice felt against groping in the darkness, and because it was well known that a safety lamp did not afford the security against roof-falls, which was given by a brighter light.

The open torch and safety lamp, alike in kind, though not in degree, befoul the atmosphere in which they burn. In fact the carbon dioxide they create, when in small quantity, is important rather as a measure of the foulness of the air they have contaminated, rather than for the harm it will do in itself.

In the room-and-pillar system of mining, every working place is more or less ahead of the air, while the smoke from lamps is carried along the face in longwall workings. Hence it is apparent that the light of the future will not be one which will emit obnoxious odors.

Miner's Elect Safety Lamp Showing Light, Battery, Holder and Belt



Connections for Charging Batteries of Lamp

The lamp illustrated herewith has been used in the Hastings mine for eighteen months. The light is furnished by a 2.8-volt tungsten bulb of ½ cp., but, with a reflector behind it, it will throw a beam of light of 4 cp. The battery has a rate of discharge of 0.5 ampere for 12 hr., but as the lamp only uses 0.25 ampere it will run for twice as long, when using 71 per cent. of the rated voltage of the cell. The battery contains sulphuric acid as an electrolyte, and is incased in a hard-rubber shell. The arrangement of the batteries on the charging rack and the nature of the connections is made plain in the accompanying chart.

A company, known as the Miners Elect Safety Lamp Manufacturing Co., of Hastings, Colo., has been formed to manufacture the lamps.

The incorporators are A. E. Thompson, Jas. Cameron, D. H. Reese, D. J. Griffith and Jos. Gaymay.

*Mine inspector, The Victor-American Fuel Co., Trinidad, Colo.

Mining Meetings

Coal Mining Institute of America

The winter meeting of the Coal Mining Institute of America will be held in Pittsburgh, Penn., Dec. 18 and 19. In addition to the president's address and a discussion on rib drawing by machinery, papers will be presented by the following members: William Seddon, Eugene B. Wilson, R. D. Hall, Thomas W. Dawson, Dr. W. R. Crane, A. C. Fieldner, E. B. Guenther, A. P. Cameron and G. R. Delamater. Prof. H. D. Pallister will read W. R. Crane's paper on the "Bering River Coal Field, Alaska."

W. Va. Coal Mining Institute

At the coming winter meeting of the West Virginia Coal Mining Institute, to be held at Parkersburg, Dec. 10 and 11, special arrangements have been made, the Business Men's Association of Parkersburg, coöperating, to make the social side of the meeting attractive. A large attendance is desired.

Pittston Coal Mining Institute

The fifth annual banquet of the Y. M. C. A. Mining Institute, of Pittston, was held Saturday evening, Nov. 30, in the State Armory.

The invocation was delivered by Rev. J. Vinson Stephens, and after the dinner had been disposed of, W. P. Jennings, president of the institute, introduced as toastmaster, Judge John M. Garman, of Wilkes-Barre. Following a song by a quartette composed of Harry Morgan, J. H. Morgan, Haydn G. Jones and Andrew McCready, Judge Garman called on Thomas Thomas, mining superintendent of the Lehigh Valley Coal Co., and ex-County Treasurer John W. Griffith, of Nanticoke, for addresses. In the course of the evening, the history of the Pittston Mining Institute was reviewed.

The mining-institute movement was begun in the bituminous field, and when plans were made to extend the movement to the anthracite region, Pittston was chosen as the best place to begin. While the growth of this particular branch has not been all that might have been desired, yet from Pittston were sent men who have formed institutes through the anthracite field, the total membership of which is now about 7500 men.

About 900 men were present at the banquet, which was served by members of the mining institute. Music was furnished by the Thistle Orchestra.

Inquiries of General Interest

Questions are not answered unless accompanied by the name and address of the inquirer. This page is for you when stuck—use it

Guarding Trolley Wires in Mines

The new bituminous-mine law of Pennsylvania is explicit in regard to all electrical installations in mines. It requires that the underground trolley wires shall be properly protected at all landings and partings where men are required to work regularly or where men must pass under the trolley or other bare power wires, whenever these wires are placed less than 6½ ft. above the top of rail. The law specifies that this protection may consist in channeling the roof and suspending the wire in the cut so formed; or, the wire may be protected by placing boards on each side of it in such a position that accidental contact with the wire will be avoided.

In the mine of which I have charge, we channel the roof wherever conditions warrant. But where the roof is too hard or cutting the roof is liable to cause a fall of slate, we guard the wire with boards. Our method is to bore holes in a 6-in. board, at distances apart corresponding to the distances between the trolley hangers. This board is placed flat up against the roof, allowing the end of each extension bolt to stick through the hole in the board. The board is held in place by a large nut, which is screwed on the end of the extension bolt, with an insulation washer above it between the nut and the board. It is an easy matter then to nail sideboards to this roofboard, so as to properly protect the wire.

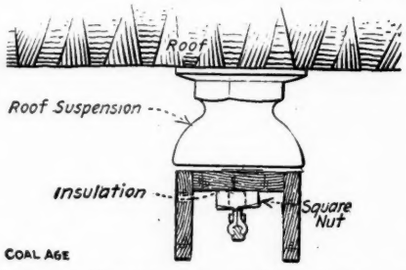
Timber does not last long in our mines and is expensive. I would like to ask if there is a better method of guarding the trolley wire, or a metal guard made specially for the purpose.

ROBERT J. MCTAGGART.

Marsteller, Penn.

The new bituminous-mine law (1911) requires the proper protection of the trolley or other power wires, in a mine, at all exposed points, such as landings, sidings or partings, or wherever men are required to pass under the wire. The law also requires that the trolley wire shall be protected at all points where the distance from the wire to any portion of the locomotive may be less than 12 in. It should not be a very expensive operation to protect these points, either by channeling the roof or by constructing a wooden trough somewhat similar to that described by our correspondent.

In the accompanying figure is shown such an arrangement with, however, a bell-shaped dome commonly used in mine work to guard against roof drippings.



WOODEN TROLLEY GUARD USED WITH OR WITHOUT BELL-DOME HANGER

There should always be an insulation washer placed above the nut holding the roofboard in place. This will provide for the proper insulation of the boards should these become wet. The box trough can be used with or without the bell-shaped dome as desired.

We know of no metal trough manufactured for this purpose. Information in regard to this can undoubtedly be had by writing manufacturers of electrical equipment of this description, say The Ohio Brass Co., Mansfield, Ohio.

Automatic Mine Doors Electrically Operated

I desire to ask if there are in use any automatic mine doors operated by an electric switch, thus allowing of the passage of the mine cars and avoiding the expense of a trapper employed to open and close the door at the passage of each car or trip.

I see many mines where small doorboys are employed to open and close the doors, at the passage of each car or trip. Since this work is dangerous work for the boys employed, and entails a considerable expense that should be avoided, it seems to me that there should be some practical mechanical device by which mine doors would be opened and closed automatically, to allow the passage of cars. My suggestion is that this work should be performed electrically. I would like to ask if such a device is known or used in any mine in this country.

CHARLES A. MITKE.

Bisbee, Ariz.

Our correspondent has drawn attention to an interesting subject. It is well known that there are many mechanical devices designed to open and close a mine door for the passage of cars or trips. To our knowledge, there are no such devices that are electrically operated.

The chief danger to which automatic mine doors expose underground car drivers is the failure of the door to open at the moment and as fully as is required, for the passage of the cars. Many a driver has been killed by the failure of an automatic mine door to open. An electrically operated door would, perhaps, be subject to the increased danger of the electric current failing or being shut off, or a fuse blowing. Any automatic device for this purpose is subject, also, to the unavoidable danger that a trifling fall of roof slate behind the door would not permit the door to open and no signal of danger would be given to the approaching driver.

We would suggest that, in any case, if such an installation was made automatic, it should be provided with danger signals that would give suitable warning, at a safe distance from the door. It might be well, in providing such an installation, to arrange it so that the door would be opened twice, by the automatic operation of switches by the approaching cars, while still at a safe distance from the door. This would show the driver that the device was working safely. Or, if it would not require too much of a derangement of the ventilating system, the door could remain open until after the passage of the cars, instead of opening twice. In any case, there should be signal lamps displayed on the entry that would indicate that the current was still flowing.

COAL AGE will be glad to hear any suggestions from superintendents and foremen, along this line; and to see an expression of opinion in regard to the feasibility of such an electrical system.

Distributing Stone Dust

Is there a machine for distributing dust in mines? INQUIRER.

Rock Springs, Wyo.

The only machine in use for this purpose is the one described by Samuel Dean, COAL AGE, Nov. 30, p. 756, who ascribes the credit for its production and introduction in mines to W. J. Murray, vice-president and general manager of The Victor-American Fuel Company.

Examination Questions

Selected from State Examinations, or Suggested by Correspondents

Special Electrical Examination

Suggested Questions

Ques.—Name the four simple units employed to measure a current of electricity; and explain each briefly.

Ans.—The four electrical units are:

1. The *ampere,* which measures the *volume,* commonly termed the strength of the current.

2. The *volt,* which measures the pressure, or intensity of the current. This is what is known as the electromotive force, in speaking of electricity.

3. The *ohm,* or unit of resistance, used to express the amount of resistance offered by a conductor or other medium to the flow of a current of electricity.

4. The *watt,* or unit of power, used to express the power developed by an electrical current.

Ques.—What is *potential,* in electrical work?

Ans.—Potential is a term that relates to the pressure of an electrical current; it is synonymous with voltage, with the difference that *voltage* implies the measure of the pressure in volts or electrical units, while *potential* describes the same pressure (electromotive force) without distinct reference to its measure.

Ques.—What is meant by the *drop in potential,* in speaking of transmitting electrical power?

Ans.—The drop in potential or drop in pressure is the loss of potential or pressure, due to the resistance of the conductor to the passage of the current. It may be said that a portion of the potential is absorbed by the resistance of the conductor.

Ques.—How does drop in potential, in electricity, compare with ventilating pressure, in mine ventilation?

Ans.—The two terms are alike in their respective applications. Ventilating pressure is the pressure required to overcome the resistance of the mine airways, or absorbed by the resistance, in the same manner as drop in potential is the potential absorbed by the resistance of the conductor. They each represent the difference between two pressures.

Ques.—Explain briefly how an electric current is measured and how its power is calculated.

Ans.—The strength (amperage) of the current is measured by an instrument called the ammeter, and the electromotive force is likewise measured by the voltmeter. Both of these instruments are introduced into the electric circuit and their readings carefully noted.

The power of the current, in watts, is then calculated by multiplying the voltage by the number of amperes in the current; thus:

$$Watts = volts \times amperes$$

A horsepower is equivalent to 746 watts. Therefore, to obtain the corresponding horsepower of an electric current, divide the product of the volts and amperes by 746; the quotient obtained is the horsepower; thus,

$$Horsepower = \frac{volts \times amperes}{746}$$

Ques.—What current will be required to develop 100 hp. under 250 volts?

Ans.—The strength of current, in this case, to develop the required power, is

$$\frac{746 \times 100}{250} = 298.4, \textit{ say } 300 \textit{ amperes}$$

Ques.—Explain the terms *dynamo, generator, motor,* in respect to their proper use.

Ans.—The term *dynamo* is applied to a machine capable of converting mechanical power into electrical power, or *vice versa,* electrical into mechanical.

A *generator* is a dynamo used to generate electrical power from some mechanical source; while the same dynamo driven by electricity and developing mechanical power is termed a *motor.*

In a generator, the *input* is mechanical power and the *output* electrical; while in a motor, the *input* is electrical and the *output* mechanical. Both are dynamos.

Ques.—Define what may be properly understood as (1) a *low-voltage,* and (2) a *high-voltage* current, in common mining practice.

Ans.—The bituminous-mine law of Pennsylvania (1911) has defined a low-voltage current, in mining practice, as one in which the conditions of the supply of electricity are such that the potential cannot exceed 300 volts.

The same law defines a high-voltage current as one in which the conditions of supply admit of the potential exceeding 650 volts. A medium voltage is defined as lying between these two; that is to say, the conditions of supply are such that the potential will exceed 300 but cannot exceed 650 volts.

It will be observed that on the basis defined by the bituminous-mine law (Penn.), as stated above, a current of 500 volts would be classed as a "medium-voltage" current only when safeguarded and protected against a possible rise of potential above 650 volts from short circuiting or any cause whatsoever. When not satisfactorily so guarded, it must be classed as a "high-voltage" current.

Ques.—What is the distinguishing characteristic of direct and alternating currents?

Ans.—A direct current, in electricity, is one that flows constantly, in one direction, through the machine. An alternating current is one that constantly changes its direction of flow.

Ques.—Why is an alternating current better adapted for the transmission of electrical power over long distances?

Ans.—Because, owing to the high potentials possible in an alternating current, a given power can be transmitted by using a wire of much less diameter than would be required for the transmission of the same power by direct current.

Ques.—What is meant by low-tension and high-tension electric fuses, in reference to blasting?

Ans.—A low-tension electric fuse is a detonator cap or exploder in which the terminal wires embedded in the fulminate are connected by a metallic bridge, generally a wire filament, which is heated to incandescence by the resistance it offers to the passage of the electric current. The heat of the wire ignites the fulminate and explodes the cap.

A high-tension fuse or exploder has no wire bridge, but its terminals, embedded in the fulminate, are close enough together to allow a spark to jump from one terminal to the other. The spark ignites the fulminate, but its production requires a current of higher potential than is required in a low-tension exploder.

Ques.—Mention a few of the most important and, at the same time, most successful applications of electricity to mining, and state which excels in importance.

Ans.—Telephone and signaling, haulage, coal-cutting and lighting installations, in mines, are all of such great importance, and their application to mining has been so successful that it is difficult to choose between them in this respect.

It is probably true, however, that the service rendered to mining by the telephone and signaling systems installed in mines is of greater importance than any of the other applications mentioned, because the others can be replaced by other means than electricity, which is not true to the same extent of long-distance telephone and signal systems in mines.

Coal and Coke News

From Our Own Representatives in Various Important Mining Centers

Washington, D. C.

The report of the Isthmian Canal Commission which has just been completed and made public, gives the first authentic information as to just what has been done on the isthmus regarding the provision of coaling facilities for passing vessels. The report states:

On the assumption that favorable legislation would be provided, general and detailed plans of the terminals were undertaken with a view to beginning the work of construction as soon as funds should become available. The general layout of the terminals at the Atlantic and Pacific entrances to the canal is arranged with the object of affording sufficient wharves and piers to meet all requirements when the canal is opened, and at the same time to permit of extension in case future needs so require. In addition to wharf space for vessels, the general plan provides the necessary facilities for docking and repairing all classes of vessels and for furnishing them with fuel, fresh water, and supplies of all kinds. As these facilities may be required for military purposes as well as commercial, all general plans were submitted to the Navy Department for its views, which have been followed in the final designs.

The main coaling plant at the Atlantic end of the canal will be located on the north end of the island opposite Dock No. 11, at Cristobal, with railroad connection across the French canal. It will be capable of handling and storing 200,000 tons of coal, with a possible increase of 50 per cent.; 100,000 tons will be in subaqueous storage. The coaling plant at the Pacific terminus will be located at Balboa, adjacent to the site of the dry dock, and will be capable of handling and storing 100,000 tons of coal, with a possible increase of 50 per cent.; subaqueous storage will be provided for 50,000 tons. Arrangements are made for supplying fuel oil, and four tanks of 40,000 bbl. capacity each, are under advertisement, which will give an initial storage capacity of 80,000 bbl. at each terminus.

The piers or docks on the Atlantic side are to be protected against storms by a mole or breakwater extending out in prolongation of the line separating the Zone from Colon. They are to be 1000 ft. in length, 209 ft. in width, and 300 ft. apart. At present the Panama R.R. Co., to meet its own requirements, is engaged in building one of the piers, with a slip on either side, and a 1000-ft. wharf, together with the necessary length of mole or breakwater to afford protection. On the Pacific side the piers for commercial use will be placed at right angles to the axis of the canal, with the ends of the piers 2650 ft. from the center of the 500-ft. canal channel. The piers will be 1000 ft. long and 200 ft. wide, with 300-ft. slips between the piers. The construction of one pier is to be undertaken. The superstructure of the commercial piers and wharves will be one-story steel sheds, with a clear height of 25 ft. The sheds, of fireproof construction, will cover the entire pier except for a space of about 18 ft. along each side and the outer ends. A track will extend along each edge of the piers at floor level, and two tracks will run through the center of the pier sheds, so depressed as to bring the car floor level with the floors of the sheds. Much study was given to providing for the economical handling and storing of freight.

An Interesting Rate Decision

An interesting decision has been arrived at by the Interstate Commerce Commission in the case of the St. Louis Blast Furnace Co. vs. the C. & O. Ry., et al., and Virginian Ry. Co., et al. In summarizing, the opinion says:

The Commission was of the opinion that the charges imposed upon complainant's shipments of coke from Page and Ansted, W. Va., and Glassport, Penn., to Carondelet were neither unreasonable per se nor unjustly discriminatory, and that they did not subject complainant to undue prejudice or disadvantage. We did find, however, that the rates collected on the shipments from Page to Carondelet that moved via New Albany, Ind., were in excess of the rate lawfully applicable thereto, but there is no evidence that such is the case with respect to the shipments here in question. There is nothing in the records in the prior cases that shows the rates now under consideration to have been unreasonable or unjustly discriminatory or otherwise in violation of the act to regulate commerce, and it follows, therefore, that these complaints should be dismissed.

The complaint in this case, which was filed Feb. 23, 1912, alleges the shipment of 236 carloads of coke, in December, 1909, and May, June and July, 1910, from Page, W. Va., to St. Louis, Mo., and that the rate of $2.90 per ton collected thereon was unreasonable and unjustly discriminatory to the extent that it exceeded a rate of $2.23 per ton. Reparation is demanded in the sum of $4,232.39. Most of these shipments moved via the Virginian Ry. from Page to Deepwater, the Chesapeake & Ohio Ry. from Deepwater to Cincinnati, the Cleveland, Cincinnati, Chicago & St. Louis Ry. from Cincinnati to East St. Louis, and the St. Louis, Iron Mountain & Southern Ry. to Carondelet, Mo. A few of the cars moved by way of Louisville, Ky., instead of Cincinnati, but over the lines above named.

Pennsylvania

Bituminous

Benscreek—The No. 1 mine of the Pennsylvania Coal and Coke Corporation was idle Nov. 25 on account of the presence of black damp in the workings. It is said that every time there is a decided change in atmospheric conditions this gas appears and the miners are unable to work.

Connellsville — Central Pennsylvania coal and coke companies are severely affected by the general shortage of labor and cars. It is said they could use 2500 more miners.

Pittsburgh—Earnings of the Pittsburg Coal Co. are steadily increasing and are said to be now larger than at any other time since the company was organized. A shortage of labor and cars is curtailing the production.

Greensburg—A coal-mining machine in the Crows Nest mine of the Keystone Coal & Coke Co. failed to work right recently and, while the operator was trying to adjust it, it reversed, killing him instantly.

Anthracite

Wilkes-Barre—A serious cave occurred in the Marcy vein of No. 2 shaft of the Barnum mines of the Pennsylvania Coal Co., at Duryea, Nov. 25. The total number of men injured has reached twelve.

West Virginia

Charleston—The West Virginia mining strike shows signs of settlement. Governor Glasscock is trying to enlist the aid of the union miners in making peace and dispensing with military protection. Many persons identified with the recent disorders are leaving the Cabin Creek district, some not taking the trouble to go by the railway route. The number of military companies on duty has been reduced to four.

Grafton—District Mine Inspector Vaughn, of the third district, will hold an examination for mine foremen and firebosses at Clarksburg, Dec. 17 and 18. This will be the last examination before spring.

Peoria—A terrific explosion of gas caused the death of two miners in Peoria, Nov. 22. The explosion was the result of entering the mine with a naked light. The gas was encountered 60 ft. from the entrance. Fire broke out after the explosion.

Tennessee

Knoxville—Since the Briceville explosion, in which 84 men lost their lives, much attention has been given to rescue drill by the operators and miners of that district. Courses are conducted under supervision of representatives from the U. S. Bureau of Mines.

Kentucky

Trosper—Fire at the Bennett Jellico Coal Co.'s mine at Trosper, Ky., destroyed the drum, and the mine will be closed down until repairs can be made.

McHenry—The coal miners of the western Kentucky fields, especially in the vicinity of McHenry, have sent to Governor McCreary a remarkable appeal, signed by a committee which claims that it represents 5000 men. It states that the miners have for eighteen months averaged only twelve days work a month, and that their average wage income during the past month has been about $10.

McRoberts—The first shipments of coal from the Consolidation Coal Co.'s mines at the new town of McRoberts, Ky., on the L. & E. extension of the Louisville & Nashville in the Harlem field, have gone out consigned to the markets of the Northwest and the Great Lakes. It is expected that 75 to 100 cars a day will be handled from this district within a short time.

Lexington—The Kentucky State Geological Survey is coöperating with the U. S. Geological Survey in meeting the expenses of the surveys in this state for the making of detailed topographical maps, and this has recently enabled the federal bureau to issue a map of the area known as the Nortonville Quadrangle, including some of the richest coal fields in the state.

Ohio.

East Liverpool—Officials of the Tri-State Railway and Electric Co. have secured, it is declared, a 90-day option on about 2000 acres of valuable coal land in and about the vicinity of the Island Run mines where are laid the present holdings of the company along the Little Beaver Creek. It is believed a new power plant may be erected. The direct object of the visit of Manager Q. R. W. Griffin, to New York City, concerned matters pertaining to the improvement of the operating end of the company's business in East Liverpool and Steubenville power plants which have been ordered by the Ohio public-service commission.

Indiana

Clinton—Crown Hill mine No. 4 is practically the only mine in this district that is not working full time when cars are available.

At the Deering No. 1 mine, which was recently opened, four men have been killed by explosions. The mine officials attribute this to hasty shooting in small space, but the coroner has not announced his verdict or finding.

South Bend—A large number of coal dealers in South Bend, Mishawaka and Elkhart were recently summoned before the grand jury to testify relative to the high price of coal, the difficulties in the way of price reduction and as to the existance of a coal combine. No true bills were returned against the dealers.

Linton—A train of 175 railroad cars is required to remove one day's output from the five Vandalia mines in Linton. For the past several days the output from these mines has not run below 7000 tons.

Jasonville—The coal mine east of the city known as the Freeman mine and owned by Frank Freeman, has been leased by Levy Sinders and will be operated by the Sinders brothers. The mine will be run at its capacity for local trade only.

Illinois

Lovington—Three dust explosions, all of them being in the back part of the main south entrance, occurred in the Lovington coal mine in the afternoon of Nov. 22. Warnings were quickly given after the first explosion and although some of the miners were severely burned on their faces, arms and hands, all were able to reach the top in safety.

New Haven—An 8-ft. seam of coal has been discovered near this city, while drilling for oil. The coal was found at a depth of 800 ft. and is said to be of fine quality.

Tilden—Wm. Stevenson, president of the Bessemer Coal & Mining Co., of St. Louis, was caught in a flywheel at the Crystal Mine here and crushed so that his wounds may prove fatal. Mr. Stevenson is a representative from the 44th District to the Illinois State Legislature.

Missouri

A series of tests on Missouri and Illinois coal, conducted at the engineering experiment station of the University of Missouri has demonstrated that for heating power and service the Missouri coal is just as good as that from Illinois. Missouri coal, cleaned as is the Illinois coal, at the mine, is better than much of the Illinois coal.

Arkansas

Little Rock—The Little Rock Chamber of Commerce has been advised by the freight department of the Missouri Pacific, Iron Mountain, of the decrease in coal rates of 25 cents per ton on slack from Arkansas mines to Little Rock. This reduction is given providing the Chamber of Commerce agrees to withdraw its complaint against the railroad now on the docket of the Interstate Commerce Commission. The Chamber of Commerce has agreed to withdraw this complaint and the new rate will go into effect at once.

Galloway—A discovery has been recently made of a bed of coal 5 ft. thick and 500 ft. below the surface. Drilling operations for oil on Mark Valentine's plantation were the cause of the discovery. Prof. N. F. Drake, state geologist, to whom specimens were sent, reports that the coal is a good bituminous coal, with excellent coking qualities. It is understood that an investigation will be made to ascertain the probable yield of the seam.

Kansas

Pittsburgh—Pittsburgh is now the headquarters of the U. S. mine rescue car No. 4, which arrived there Nov. 21. This car will in future have charge of the southwest division, consisting of Oklahoma, Arkansas, Missouri, Kansas and part of Illinois.

Colorado

Lafayette—The fire in the Simpson mine has become such a menace to the lives of the miners that the U. S. Bureau of Mines has been called upon for assistance in coping with the danger. The rescue car, whose crew has been fighting the fire in the Smuggler mine at Aspen, is now at Lafayette.

Wyoming

Rock Springs, Wyo. — Development work on the property of the Lion Coal Co. is progressing nicely and it is expected that shipments will commence the first week in December. Electricity will be employed entirely in the mining and handling of the coal and it is anticipated an excellent product will be placed on the market.

Foreign News

CANADA

Lethbridge, Alta.—The province of Alberta has opened a mine rescue station at Lethbridge. The station is fully equipped, and W. J. Powell, former U. M. W. A., president of District 18, is in charge.

The Rocky Mountain Branch of the Canadian Mining Institute met in Lethbridge, Nov. 20 and 21. Several interesting papers were read and the principal mines of the field were visited.

FRANCE

Alais—Twenty-four men lost their lives here Nov. 24, when firedamp exploded in a coal mine. Fortunately the accident occurred between shifts and only 38 men were in the mine at the time. Of these, 14 were warned by the sudden extinction of their lamps and managed to escape. A rescue party found 21.

Recent Coal and Coke Patents

Hoisting and Conveying Apparatus. J. L. Potter, Indianapolis, Ind. 1,042,264, Oct. 22, 1912. Filed Mar. 11, 1912. Serial No. 682,847.

Drill Extractor. B. F. Betts, Mazuma, Nev. 1,042,873, Oct. 29, 1912. Filed Mar. 5, 1912. Serial No. 681,753.

Elevator Safety Device. C. S. Mortenson, Moline, Ill. 1,042,813, Oct. 29, 1912. Filed May 16, 1912. Serial No. 697,817.

Blast Furnace Coaling Device. F. D. Carney, Steelton, Penn. 1,042,767, Oct. 29, 1912. Filed June 15, 1912. Serial No. 703,909.

Gas Producer. C. A. Kuenzel, assignor to Kuenzel Gas Producer & Smelter Construction Co., a corporation of Washington. 1,042,566, Oct. 29, 1912. Filed Nov. 29, 1911. Serial No. 663,047.

Machine for Mining Coal. L. G. Williams, Hopkinsville, Ky. 1,043,183, Nov. 5, 1912. Filed Oct. 28, 1911. Serial No. 657,202.

Method of Operating Gas Producers. H. L. Dougherty, New York City. 1,043,213, Nov. 5, 1912. Filed Apr. 13, 1911. Serial No. 620,860.

Safety Appliance for Pit Cages, Lifts and the Like. G. W. Lester, Bangor, Eng. 1,043,323, Nov. 5, 1912. Filed July 13, 1911. Serial No. 638,387.

Mine Car Brake. D. W. Anderson and W. M. Boyce, Clearfield, Penn., and F. W. Hollopeter, Glenope, Penn. 1,043,498, Nov. 5, 1912. Filed Jan. 20, 1912. Serial No. 672,330.

Combination Gas and Coal Grate. Michael L. Scanlon, Cleveland, Ohio. 1,043,871, Nov. 12, 1912. Filed July 15, 1912. Serial No. 709,549.

Smoke Consuming Furnace. S. O. Berg, Chicago, Ill. 1,043,895, Nov. 12, 1912. Filed Mar. 23, 1912. Serial No. 685,675.

Personals

E. B. Sutton, engineer in charge of the Knoxville mine rescue station, has gone to the Coal Creek field to do some special work in his department, and to drill the miners in mine-rescue tactics.

W. E. Mathews, of Stonega, Va., general superintendent of the Stonega Coke & Coal Co., resigned his position, effective Dec. 1, 1912. His successor has not yet been appointed.

Charles M. Barnett, president, J. L. Moon, assistant to president, and F. R. Wadleigh, assistant general manager, have resigned their positions with the Chesapeake & Ohio Coal & Coke Company.

Publications Received

"The Standard" Concrete Mixer. Bulletin Y 50. 32 pp.; 6x9 in.

The Standard Scale & Supply Co., Pittsburgh, Penn. Illustrated price list, No. A 160. Aug. 1, 1912. 138 pp.; 3¾x6¼ in.

University of Illinois, engineering experiment station, Urbana, Ill. The Coking of Coal at low Temperatures, with a preliminary study of the byproducts. By S. W. Parr and C. H. Olin.

S. E. Hendricks Co., Publishers, 74 Lafayette St., New York City. "Hendricks' Commercial Register of the United States for Buyers and Sellers." 1575 pp.; 7½x10½ in.; cloth.

The total number of classifications in this book is over 50,000, each representing the dealers or manufacturers of some machine tool, specialty or material required in architectural, mechanical, electrical, and mining engineering and kindred industries. They are so arranged that the book can be used for purchasing and mailing purposes.

This work will be expressed to any part of the country for $10.

Construction News

Pomeroy, Ohio—The Hocking Valley R.R. will build a 12-mile extension from the east end of Pomeroy to the coal fields adjoining.

Birmingham, Ala.—The North Alabama Coal, Iron & R.R. Co. has awarded a contract for a tipple and slate picker at the mines in the city limits and which were formerly known as the Hammond mines.

Elkhorn City, Ky.—The Carolina, Clinchfield & Ohio R.R. has secured a tract of 40 acres near Elkhorn City, on its new extension into the Eastern Kentucky coal region, and will erect large yards and shops.

Kittanning, Penn.—The mines of the Providence Coal Co., near Kellys Station, will be put in shape for a daily output of 1000 tons as soon as extensive improvements are made, including a modern tipple and power house.

Albia, Iowa—A motor is being installed at the new coal mine near Harvey to haul coal from the mine to the railroad switch on the Burlington. About 40 men are now employed at the mine, and when the new machinery has been installed 60 more will be needed.

East St. Louis, Ill.—The Southern Coal & Mining Co., of St. Louis, whose coal washer at Lake, Ill., was recently destroyed by fire, have applied to the building commissioner for a permit to erect a $35,000 coal washer on the Illinois shore of the Mississippi River, near the new Municipal Bridge.

Chehalis, Wash.—The Sheldon Coal Co. is commencing work on the concrete bases for the understructure of their new bunkers. W. F. West, a former St. Helena man, who is interested in the company, says that if everything goes along as nicely as it has been, the first coal will be shipped within three weeks.

Edmonton, Alta.—The St. Albert Collieries, Ltd., a subsidiary of the Canadian Coal & Coke Co., will complete its new shaft, which is 38 ft. in diameter and 300 ft. deep, before the close of the year. The shaft, built entirely of concrete, is said to be the first of its kind in Canada. The property has an area of 7 square miles, and the plant will cost about $750,000.

Spangler, Penn.—Proposals are asked for sinking a two-compartment hoisting shaft 12x24 ft. in the clear, a depth of about 100 ft., and an airway and manway shaft 12x24 ft. in the clear, a depth of about 80 ft., both shafts to be reinforced concrete from surface down to the solid rock, walls to be 2 ft. in thickness and of first-class quality of material and workmanship, until Dec. 10, by the Brubaker Coal Co.

Lisbon, Ohio—The Mullins Coal Co. is rapidly equipping an old plant of the Quaker Coal Co., near here into one of the most uptodate mining plants in eastern Ohio. Improvements are nearing completion and the mines will soon be in operation. The improvements include a large brick boiler and engine house. A tipple of the latest type will be erected on a concrete foundation. Double tracks are being laid to the plant from the main line of the P., L. E. & W., over which the product will be carried.

New Incorporations

Hawks Nest, Va.—The River Valley Colliery Co., Hawks Nest, Va., was recently incorporated with $25,000 capital stock to develop coal land.

Grand Rapids, Mich.—The I. C. Shipman Coal Co. has been reorganized from a copartnership to a corporation. I. C. Shipman is president.

Birmingham, Ala.—The Norton Coal Mining Co. Capital stock $300,000. To acquire by purchase or otherwise coal lands and to improve and develop the same.

Centralia, Wash.—Articles of incorporation have been filed Nov. 11 with the Lewis County auditor by the Washington Coal Mining Co. Capital stock is $30,000.

Chattanooga, Tenn.—Application for a charter has been filed by the Chattanooga Iron & Coal Corporation. Capital stock, $2,500,000—preferred stock, $1,000,000; common stock, $1,500,000.

Magnolia, Ohio—The Magnolia Coal Co., of Magnolia, Ohio, has been incorporated with a capital stock of $5000, to mine and deal in coal. The incorporators are John H. Rice, John J. Williams, Emmet C. Close, D. O. Vankirk and L. H. Scheideiger.

Donwood, W. Va.—Eureka Coal Co., of Donwood, W. Va., coal mining, capital $100,000. Incorporators are Geo. W. McClintic, W. B. Matthews, Lawrence P. Williams and R. G. Walsh, of Charleston, W. Va., and C. D. Hopkins, of Athens, Ohio.

Birmingham, Ala.—With a capital stock of $60,000 the Kyomie Coal Co. has filed articles of incorporation. The officials of the concern include W. Perry, president; T. B. Perry, secretary and treasurer. The company will develop coal land in Bibbs County.

Northfork, W. Va.—The Burn Fine Coal & Coke Co. has been incorporated at Northfork, W. Va., to handle coal and mineral lands, by G. C. Wood, J. A. Kelly, of Powhatan, W. Va.; A. J. Dalton, Irvin Davis and Walter Prockter, of Northfork, W. Va. Capital stock, $10,000.

Beury, W. Va.—J. P. Chapman, of Beury, W. Va.; F. W. Chesrown, S. M. Dunbar, A. M. Slater and M. T. Kearney, of Pittsburgh, Penn., have organized at Gauley Bridge, W. Va., the Ajax Coal & Oil Co., to engage in the oil and coal business. The capital stock will be $300,300.

Connellsville, Penn.—Incorporation papers have been granted to the West Pennsylvania Coke Co. Capital stock is $50,000. The company will enlarge its 25-oven plant near Hecla, Westmoreland County. Holmes Davis is in charge of the Marion plant, which has been in operation about five years.

Crown Hill, W. Va.—The National Bituminous Coal & Coke Co. has been organized at Crown Hill, W. Va., with an authorized capital stock of $2,000,000, to mine, manufacture and handle coal and coke. The incorporators were C. G. Leavens, H. Lyon Smith, of Washington, D. C.; Arthur E. Wood, E. W. Alexander, L. M. Bostick, of Charleston, W. Va.

Birmingham, Ala.—Articles of incorporation have been filed by the Tuscaloosa Export Coal Co. in the probate office. The capital stock is only $2000, but it is understood that development along a larger scale will take place in the near future. Work has already been started and a mine will be in operation before many months.

Altoona, Penn.—Application will soon be made for the charter of a corporation to be known as the Pennsylvania Southern Ry. Co., for the purpose of operating a standard gage railroad connecting the Huntington and Broadtop R.R., at Markiesburg and the East Broadtop R.R. line near the tunnel. This railroad will traverse a country rich with large deposits of coal and fireclay.

Industrial News

Mt. Clare, W. Va.—The new coal mine recently opened here by Stout & Reynolds will be operated by the Burrows Hill Coal Co.

Rimersburg, Penn.—East Brady & Raridan Coal Co. are preparing to open and operate the lower vein of coal at their Hardscrabble mine.

Boston, Mass.—The coal elevator of the City Fuel Co.'s plant at Station St., Mt. Hope, has been destroyed by fire entailing a loss of about $3000.

Morganfield, Ky.—The properties of the Thomas Coal Co., at Morganfield, Ky., have been purchased by the Beddall Coal Co., which will conduct active operations.

Carterville, Ill.—The Lake Creek coal mine, located on the Marion-Johnson City branch of the Missouri Pacific, has been sold to the Furlough Coal Co. for $150,000.

Hannastown, Penn.—The Jamison Coal & Coke Co. has opened a new tract of coal on the west side of its mine at Hannastown. Electric haulage is to be installed.

Washington, D. C.—The U. S. Bureau of Standards has placed the legal weight of a bushel of coal in Pennsylvania at 76 lb., and in Ohio and West Virginia at 80 lb.

Tuscaloosa, Ala.—The Castellano & Dean Realty Co., Jacksonville, Fla., will develop coal lands near Tuscaloosa, Ala., and plans daily capacity of 700 to 1000 tons of coal.

Indiana, Penn.—The Savan Coal Co., which recently purchased the Lowry coal and some adjoining territory near Deckers Point, have commenced the opening of the new mines.

New Castle, Penn.—Charles Flechinger, of East Shenango, Mercer County, has sold what is known as the Connor farm to Pittsburgh parties, who will develop the coal on the place.

Black Lick, Penn.—The Graff coal works, closed for months because of disagreement on terms of right of way, will reopen soon. The company employs 150 men, when running full.

Dayton, Penn.—The Summit Coal Mining Co. is opening new mines on the farm formerly known as the J. T. Irwin farm, and it is rumored that they will build about 30 houses for their miners.

Connellsville, Penn.—Within the past 30 days the Pittsburg-Buffalo Co. has paid $70,000 par value of its bonds. On Nov. 1, the Four States Coal Co., a subsidiary concern, paid $100,000 of bonds.

Greensburg, Penn.—The Keystone Coal & Coke Co., of Greensbirg, Penn., contemplates reopening the mine near Hunker station, which has been closed several years. Engineers are locating a new pit mouth, tipple and siding.

Bellefonte, Penn.—Four diamond drills are testing out a large coal field, consisting of nearly 50,000 acres, that is now under option in Indiana County near Marion Center. The tract extends from Nashville west two miles below Willet.

Salem, Ohio—Salem coal mine, located on the Y. & O. R.R. near this city, has been leased by the Dunn Coal Co. Wm. Dunn, manager, under its previous owner, will remain in charge. Output of the mine is to be gradually increased.

Honolulu, Hawaii—A rumor that a Japanese steamship line is securing options on land in Honolulu for the erection of a modern coaling plant has been reproduced in a government report, without comment on the part of the officials.

Charleston, W. Va.—H. Lyon Smith, secretary and treasurer of the National Bituminous Coal & Coke Co., recently consummated a deal by which his company takes over the holdings of the Holley & Stephenson Coal & Coke Co., at Elksdale.

Johnstown, Penn.—The Manor Real Estate & Trust Co., a subsidiary of the Pennsylvania Co., which recently purchased a tract of 9000 acres of coal lands in Cambria and Indiana Counties has closed a deal for an adjoining tract of about 1000 acres.

Wheeling, W. Va.—E. M. Robinson has purchased the Clarksburg Northern Ry. for himself and several associates. The road, as projected, is to be 60 miles in length, opening up valuable coal and timber lands from the Ohio River to New Martinsville.

Ebensburg, Penn.—The Ebensburg Coal Co. has obtained options on about 3000 acres of coal land north of here, and it is expected that a deal will be closed for their purchase before Dec. 15. The option price is said to be in the neighborhood of $85 an acre.

Connellsville, Penn.—Work of raising the Dawson bridge, in order to span the tracks of the Pittsburgh & Lake Erie R.R., is to be started at once. Improvements of this company at Dickerson Run will include the first concrete and steel coaling station on this division.

Newell, Ohio—Options are now being renewed on the coal rights of over 6000 acres of valuable lands back of this city by New York people. B. A. Greer has been renewing the options secured several months ago. It is said that a 6-ft. bed of coal underlies the entire lease.

Connellsville, Penn.—Reports have been received from Smithfield to the effect that negotiations for the purchase of the plant of the Pennsylvania Coke Co. by the Republic Iron & Steel Co. have failed. The Penn works operate 80 ovens and have long been established.

Connelsville, Penn.—The Whitsett coal mines on Pittsburgh, McKeesport & Youghiogheny R.R., opposite Layton Station, have been purchased by Osborne & Sager, with mines on Wheeling division of B. & O. R.R. and at West Newton. Two mines and 1000 acres of coal land cost about $12,000.

Washington, Penn.—One of the biggest coal deals consummated in this county for some time was closed Nov. 30, when Virgil McDowell, of Midway, signed an agreement to purchase a block of 1400 acres near Hickory, at $135 an acre. This tract is near the operations of the Pittsburgh and Atlas Coal companies.

Johnston, Penn.—The latest transaction in Somerset County is the leasing of 5000 acres of coal and timber land in Middle Creek and Jefferson Townships by capitalists of Uniontown, Rockford and Pittsburgh. It is understood that mining operations will be commenced as soon as the timber has been cleared.

Dickinson, N. D.—Four miles east of here a new mining town has been established and everything will soon be in readiness to ship a high grade of lignite coal. The seam is 11 ft. thick and is supposed to be the same one as is worked by the Lehigh miners. Pittsburg has been suggested as the name for the new mining town.

Connellsville, Penn.—Buying of coal land in lower Fayette is unusually active. Dower farm, 61 acres, near High House, purchased by J. C. Work, W. E. Crowe and C. F. Kefover, of Uniontown, for $70 per acre. Harry and George Whyel bought 32 acres of coal from Walter Laughead and Jasper Augustine, Georges Township.

Mahaffey, Penn.—The Clover Run mine of the Madeira-Hill Coal Mining Co., located near Mahaffey, has resumed operations after being idle for a period of several months. A force of 200 miners will be employed at the operation, which has an output of 300 tons daily. Supt. W. R. Wilburn says that the output is to be doubled within a short time.

Ebensburg, Penn.—The Ebensburg Coal Co. has employed the Fetterman Engineering Co., of Johnstown, Penn., to survey the coal properties optioned by the corporation some months ago, and it is expected that deals for the field will be closed very soon. There are 3000 acres in the tract, including about 1000 acres held by J. L. Mitchell for some time.

Boswell, Penn.—Another mine has been opened here by the Standard Quemahonong Coal Co. This company was formed but two years ago, and recently the demand for its product has been so great that further extension of operation has been found necessary. The output is now about 350 tons a day, and when the new mine is ready this will be greatly increased.

Baltimore, Md.—The Alexander Milburn Co., manufacturers of various acetylene apparatus, including mine lamps, announce that they have just moved their offices and works into new and more commodious quarters at No. 1420-26 West Baltimore St. Less than two years ago this company materially enlarged their plant, but their rapid development and growing requirements recently rendered further expansion imperative.

Charleroi, Penn.—Seventy-five acres of land lying along the Monongahela R.R., between Allicia and Maxwell, above Brownsville, became the property last week of Luzerne Coal & Coke Co. It is the intention of the new owners to begin immediate preparations for the erection of a coke plant to consist of 40 ovens at the start. J. A. Hillman, Jr., of Pittsburgh and Holmes A. Davis, of McKeesport, formerly of S. Brownsville, are the chief backers of the new company.

Shadyside, Ohio—Geo. M. Jones Co., of Toledo, is opening an immense new mine a mile and a half south of Shadyside on the Ohio side of the river, and when in full operation it will employ at least 300 men. Electricity will be used for motive power. The Geo. M. Jones Co. owns a big tract of coal south and west of Bellaire, and have several mines in operation now. A third rail has been laid over the Ohio & Western to the plant and the Pennsylvania will extend their switch up to it from the Wegee gravel pit.

Coal Trade Reviews

Current Prices of Coal and Coke and Market Conditions in the Important Centers

General Review

For the first time in many months there was evidence of a break in the anthracite market, and quotations on premium coal suffered a sharp decline at one or two points, notably New York, for instance. This followed a report that the companies were giving out more coal and may also be partly ascribed to the mild weather. The situation cannot be termed easy, especially at the more remote points, but the indications are that the market will shortly assume the average normal winter proportions.

Small receipts and cold weather are reducing the stocks of the Eastern bituminous consumers, and the trade is on a firm basis, but there is an absence of snap and quotations remain conservative. The curtailment in production over the Thanksgiving holidays restricted the arrivals noticeably.

In the Pittsburgh district a large proportion of the business for 1913 was put under contract during the week, at the prevailing circular; some large coke contracts have also been let. The car supply, which has been rather poor, will show a decided improvement, now that shipments to the Lakes have been concluded. Larger tonnages are being moved in Ohio, and the situation in regard to supplies is somewhat easier; domestic is holding steady, with an increasing demand following the cold snaps.

At Hampton Roads the movement on contracts continues heavy; no quotations are obtainable on smokeless, and the high volatiles are bringing record prices. In the South the only spot coal available is that from mines which have been partially closed down and produce an off quality. The car shortage at this point is becoming worse.

The Middlewestern market reports the heaviest demand for steam coal in the history of the trade; it is thought the situation will be easy, however, if the mild weather continues through December. Cars are still scarce but showing some improvement.

Boston, Mass.

The colder weather and small receipts are reducing the stocks of bituminous. There is no effect on prices as yet, but if the present status continues through December, and there is every likelihood it will, there should be some high prices late in the month or early in January. Already, Pennsylvania coals are beginning to be shipped here on consignment and are being held at prices very nearly up to present quotations on the higher grades from West Virginia. The textile and other manufacturing plants of New England are operating on full schedule and fuel consumption is understood to be well above the normal.

The loading situation at Hampton Roads shows no improvement. Contractors who have tonnage waiting for Pocahontas and New River to be mined, are paying dear for the privilege. The market is strong in all directions. Georges Creek coals are not to be had except at Baltimore, and there is better inquiry for the ordinary grades of Clearfield. There is a lack of snap, however, and current purchases are conservative.

November receipts of hard coal here were extremely light and dealers are correspondingly disappointed. Even the most far-sighted of them are in straits for coal for the small deliveries that are the rule. They are just able to scrape along with what shipments can be had. Lake navigation closed Nov. 30, but it is believed here that the extra consumption in the big cities will at least offset any additional supply that might otherwise come to this market.

Current quotations at wholesale are about as follows:

Clearfields, f.o.b. mine	$1.45@1.80
Clearfields, f.o.b. Philadelphia	2.70@3.05
Somersets, Cambrias, f.o.b. mine	1.65@2.00
Somersets, Cambrias, f.o.b. Philadelphia	2.90@3.25
Pocahontas, New River f.o.b. Hampton Roads	3.50
Pocahontas, New River on cars Providence	4.50@4.75
Pocahontas, New River on cars Boston	4.50@4.75

New York

Anthracite—The long-continued tightness in the hard-coal market experienced a decided break during the week, due to a combination of weather conditions and the giving out of more coal by the companies. The change has been abrupt and decisive, and many dealers are inclined to believe that normal winter conditions will prevail in this market by the middle of the month; this means a uniform premium of about 50c. per ton on the domestic grades. The market is governed entirely by the weather, which has been particularly favorable to the consumers. This has resulted in a rather light consumption to date, and probably accounts, in a measure, for the present slump.

It is rumored that some of the companies are sending out salesmen to New England, which is evidence that they are becoming anxious about securing new business. Prices experienced a general falling off all along the line, and we now quote the New York market as follows:

	Upper Ports	Lower Ports
Broken	$5.00	$5.00
Egg	5.25	6.00 @ 6.25
Stove	5.25	6.50 @ 6.75
Nut	5.50	6.50 @ 6.75
Pea	3.50	3.50
Buckwheat	2.75	2.10 @ 2.70
Rice	2.25	1.85 @ 1.95
Barley	1.75	1.25 @ 1.70

Bituminous—There is also an easier tone to the soft-coal market at tide, due, in all probability, to the weather conditions. The line trade continues excellent, but there is not much demand except on contracts.

It is not believed that the market has suffered any reverse during the week, although it is being held down by the late winter. Heavy tonnages arrived during the early part of the week, but later the effects of the delay in mining over the Thanksgiving holidays were apparent. This resulted in a hardening of the situation during the last of the week.

We continue last week's quotations of the nominal market, although sales of the lower grades were made on a basis of 10c. below these quotations:

West Virginia, steam	$3.20@3.25
Ordinary grades, Pennsylvania	3.20@3.25
Fair grades, Pennsylvania	3.20@3.25
Good grades, Pennsylvania	3.25@3.30
Best Miller, Pennsylvania	3.25@3 30
Georges Creek	3.50

Pittsburgh, Penn.

Bituminous—Coal has been selling freely under contract in the past week or ten days, with the announcement of circular prices for the new season. These were noted in the last two reports, on the basis of $1.30 for mine-run, and represented an advance from $1.25, which some of the operators had announced a few weeks earlier. A number of sales have been made for three or four months, or for delivery up to Apr. 1, while a considerable portion of the annual business, covering the calendar year 1913, has been put under contract. In a few cases contracts have been written for the period up to Apr. 1, 1914, when the pres-

ent mining scale expires. Beyond that date the operators do not care to contract at this time.

Car supply opens the week fairly well, as it usually does, but as Lake shipments are now over, the supply is expected to continue good through the week. The labor supply was unsatisfactory throughout the Lake movement period, and has been particularly short in the past few weeks.

No business of any moment has been transacted in prompt coal, as with the close of the lake season there is no particular demand for prompt shipment. Regular circular prices, which obtain in the case of extended deliveries, remain as follows: Slack, 90c.; nut and slack, $1.05; nut, $1.25; mine-run, $1.30; ¾-in., $1.40; 1¼-in., $1.55, per ton at mine, Pittsburgh district.

Connellsville Coke — Shipments decreased somewhat at the close of last week, on account of the usual insufficient labor supply Thanksgiving Day and the two days following, and this has brought an extra demand for prompt coke this week, which has served further to stiffen the market after the weakness which developed ten days or a fortnight ago. The prompt market is now firm at $4, at which price it is believed the present demand for prompt can be satisfied. One of the largest contracts in the market has just been closed, which involves about 30,000 tons of furnace coke per month, and the price is understood to have been a shade above $3. Another contract of about 8000 tons per month over the year has been closed, at about $3.10. It is doubtful whether any furnace coke can be bought as low as $3 for the year or $3.25 for the half year, but on the other hand as much as 25c. above these prices would hardly have to be paid, unless for particularly desirable brands. We quote the market as follows: Prompt furnace, $4; contract furnace, first half, $3.25@3.50; contract furnace, year, $3@3.25; prompt foundry, $4.25@4.50; contract foundry, $3.25@3.75.

Production for the Connellsville region is given under "Production and Transportation Statistics."

Philadelphia, Penn.

Cold weather has brought with it no change in the anthracite situation here. Stove coal still continues to be the most active in demand, with egg and chestnut a little easier. Pea is also becoming a rather scarce article, and spot coal is already bringing a premium.

The demand seems to be on the increase, but it is not thought, however, that there will be any unusual shortage in this locality, and orders are being filled fairly prompt. Cars of coal are now unloading direct onto carts, and very few of them have any coal in stock. The cessation of Lake navigation on the first of December is expected to divert considerable tonnage to the East, which will in a way help matters.

Mining continues at a good rate, in fact, more coal is being brought to the surface than ever before; operations are only hampered by lack of cars, which still continue in short supply. The holidays during November, coupled with the short car supply, however, is likely to prevent any great showing for that month in the way of tonnage.

Bituminous coal, as far as prices are concerned, had an upward tendency during the past week. Ten cents and more was being asked over prices current during the previous week, and stiffer quotations are likely to come as the winter progresses.

Baltimore, Md.

Although the closing of the Lake traffic tended to ease the situation up somewhat the early part of the week, the market became exceptionally firm during the last half, and the trade reported higher prices than have been received at any time since the present activity set in. The past three days all low-grade coal has brought from $1.65 to $1.70 at the mines, which is the highest level reached for months. This was due to the Thanksgiving holiday, which really extended until Saturday. Practically all of the men remained away from the mines on Friday and Saturday.

The movement from the Somerset and West Virginia fields to tidewater was satisfactory, notwithstanding the cold spell, which was followed by snow in some sections. Local operators are still crying for more cars, although the situation has shown a marked improvement in these parts. Shippers on the Western Maryland are faring pretty well, and the Baltimore & Ohio is receiving back many of its own cars which have been held for weeks on foreign lines; at one time this latter road had over 40,000 cars on other lines. It was also one of the first roads to report to the commission named by the American Railway Association to handle the car shortage. This complaint was against the Wheeling & Lake Erie and it is believed it will result advantageously to the B. & O.

The anthracite market continues strong and there is also a good demand for coke.

Coal, destined for Algiers, was loaded on the steamer "Broderic" at the Port Covington piers of the Western Maryland Railway during the week; this is the first consignment to that point since the piers were built. The J. K. Demmick Co., of Philadelphia, made the shipment and the cargo totaled 4500 tons.

Buffalo, N. Y.

The bituminous-coal market is strong, in spite of the predictions that prices will soon go off materially; the reason for holding them up is probably due to the fact that cars are so scarce. If they should suddenly become plenty, there would soon be a surplus in consumers' hands, but at present the output is not enough to afford more than is needed from week to week. The car supply is as short as ever, and reports come in from all directions that the miners are also idle a great deal.

The real strength of the bituminous market is, of course, due to the consumption, which is as large as ever and promises to continue. It is agreed that business is too active to last very long, but it is hoped that it may slack back to the normal gradually and not produce any difficulty. If there is to be any reduction in price on account of the closing of the Lakes it has not appeared yet. There is considerable demand on the part of consumers for contracts, sometimes for 12 months.

Quotations are still on the basis of $3.20 for Pittsburgh lump, $3.10 for three-quarter, $3 for mine-run, with slack so scarce that a fixed price is not common. Coke continues as scarce as usual, on the basis of $6.50 for 72-hour Connellsville foundry.

There is a slight reduction in the premium on independent anthracite and it is expected that, with the closing of the Lakes early in December, there will be a supply sufficient to cut it out entirely. The premium is not now above $2 a ton.

The shipment of anthracite by Lake for the week was 144,000 tons and for November, 614,830 tons, which brings the season total to 3,838,485 tons, or only about 40,000 tons less than for last season to December. As only 38,500 tons was shipped last December, the two totals are bound to be about the same.

Columbus, Ohio

Coal trade throughout the state shows an improvement over last week. Larger tonnages are being moved by operators and there is some relief in the car situation. Most all of the mines in the state are working better and as this is the last week of navigation it is expected that operators and jobbers will be able to gain some headway with their shipments. Cold weather, which set in the middle of the week, has caused a decided gain and prices are in favor of the operating companies.

Domestic trade is holding up steadily with the cold snaps increasing the demand. Dealers are optimistic with regard to cars and this has caused considerable delay in deliveries. Refusal to accept consignments in hoppers has worked a great hardship upon the trade. However, these delays and requirements are helping to give steam-coal delivery the preference.

Steam business at this time is one of the strong features of the market and manufacturers and mills are still de-

manding large shipments. Efforts are being made by many steam users to lay in stocks in anticipation of continued extensive activity during the winter months.

Quotations in Ohio fields are:

	Hocking	Pittsburgh	Pomeroy	Kanawha
Domestic lump	$2.00		$2.35	$2.25
4-in	1.80	$1.60	2.00	2.00
Nut	1.50		2.00	
Mine-run	1.50	1.50	1.75	1.75
Nut, pea and slack	1.00		1.25	1.10
Coarse slack	0.90	1.25	1.00	1.00

Hampton Roads, Va.

While coal has been much in demand this month it appears that the dumping at Hampton Roads when the official figures are known, will show that November has been the poorest month during 1912. A fair estimate is about 700,000 tons. Heavy dumping has been done the past few days, but the poor showing earlier in the month could not be overcome in the short time.

No quotation can be obtained on smokeless coal; offers of from $3.25 to $4.25 are rumored, but no sales heard of. High-volatile coal is being sold at astonishing high prices and is practically the only available steam coal now on the market. The good weather prevailing during the month has been a timely relief to the overburdened shippers. Should a severe spell of weather suddenly sweep over the East and South, operators could not begin to meet the resulting demand for coal. There being only a light tonnage to move, vessels are not in demand and rates are easy.

Birmingham, Ala.

The spot coal now being offered is usually from mines which have been partially closed down during the summer and fall, and, as a rule, the quality is below the average. The consumers, however, are gladly taking any surplus fuel offered and are paying exhorbitant prices.

Practically all of the coal salesmen have been called in by their respective companies, owing to the fact that all available coal can easily be disposed of by letter. It is believed this condition will continue until well after the holidays.

The car shortage takes a more serious aspect from day to day. One of the largest railroads in the district, which has so far been the only one to supply the mines on its lines, is now falling down in this respect.

The blast furnaces and coke manufacturers are beginning to lay in stocks of coal to tide them over the holidays, and this is naturally lessening shipments to miscellaneous steam consumers, most of whom have small stocks on hand.

Knoxville, Tenn.

Despite an unusually mild November, except for the last week, there was no slackening up of the demand for domestic coal, while steam is firm. If there had been severe weather in November, it is probable that prices would have gone soaring. As it is, with normal December weather, quotations will undoubtedly be satisfactory to the operators.

Railroads promise no relief from the car shortage before the first of the year. The activity of all furnaces and industrial plants has absorbed coking coal which has heretofore been thrown on the commercial market. Furnaces are now quoting prices on delivery and making contracts for the last quarter of 1913, so it is certain that the commercial market will be free of any surplus from mines whose product goes to the coke ovens.

It appears that operators in the Kentucky-Tennessee field should fare quite well through this season. Considerable tonnage is going from this field to the Northwest, relieving the Southern market and strengthening prices there.

Indianapolis, Ind.

The Thanksgiving holiday was the chief disturbing factor in the coal industry this week. There has been a moderate improvement in the car situation and many mines have been able to get in practically full time.

Some consumers, on account of the scare, bought more heavily than usual in an effort to stock up for the winter, so that the volume of business was not reduced as much as would appear. Likewise, retailers have been as insistent lest they be caught short later on. The car shortage has interfered with the effort to stock up while the weather was mild and operators and retailers say that little headway has been made toward getting prepared for winter weather. If December turns out mild the strain may be relieved, and there may be some easing of prices when the new year opens.

The following prices, f.o.b. mines, are quoted:

No. 4 mine-run	$1.25
Nos. 5 and 6 mine-run	1.15
No 4 steam lump, 1¼-in	1.50
Nut, No. 4	1.60
Egg	1.60
Domestic lump 2½-in	1.85
Domestic lump 5- and 6-in	2.00
Screenings, No. 4	0.95
Screenings No. 5 and 6	0.85
Washed coal, Nos. 1 and 2	2.00
Brazil block	2.60

Prices f.o.b. Indianapolis are 50c. higher than above.

There is more trouble with moving cars at terminals than elsewhere, the terminal points being congested. The railroads, too, are holding many cars for their own coal supply.

Detroit, Mich.

Bituminous—Coal men of Detroit claim they are facing a shortage that will tie up many important industries during the coming season, if the relief that was looked forward to is not found immediately. It was stated sometime ago that a coal shortage on bituminous was not to be feared, but conditions at the present time are taking on a more serious aspect. Several of the local railroads are embargoed and will not accept coal from each other, nor can it be transferred for reconsignment for consumers out in the state. The coal roads of the South are keeping very close tab on their equipment and since the embargo has been raised are only sending cars in limited numbers.

The following prices prevail today:

	W.Va. Splint	Gas	Pocahontas	Hocking	Jackson Hill
Domestic lump	$1.90		$2.75	$2.10	$2.75
Egg	1.90		2.75	2.00	2.75
¾ lump	1.50	$1.50		1.65	
Mine-run	1.25	1.25	1.75	1.35	
Slack	1.00	1.00	1.50	1.00	

Anthracite—Very limited shipments of hard coal are reaching Detroit, but the price has dropped from $1.75 to $1.50 above the circular. Premiums have been so great that large consumers are refusing to pay the exorbitant price.

Coke—Manufacturers have raised the price of coke 25c. per ton above the circular. This was done because of the unusually heavy demand for coke as fuel. All sizes are now being quoted $5 f.o.b. Detroit for gas house and $5.25 for Semet Solvay.

Chicago

Chicago dealers report the heaviest demand for steam coal in the history of the trade here. While a softening in prices has been noted here and there, the general tone of the market continues strong.

There has been no change in the Hocking Valley field. Cars are scarce and industries located nearer the mines are taking all the coal that remains after the lake trade has been satisfied. The Chicago & Eastern Illinois road is supplying an increased percentage of cars and the management of the Burlington announces that it is able to comply with all reasonable demands for coal transportation.

The market for coke remains very firm. The hard cokes are almost impossible to obtain and the ovens are sold up on the domestic cokes so that deliveries will not be completed on current orders for about two months.

Prevailing prices at Chicago are:

	Sullivan Co.	Springfield	Clinton	West Va.
4-in. lump	$2.87			
Domestic lump		$2.57	$2.72	
Egg	2.87			$3.55
Steam lump		2.12	2.27	
Mine-run	2.07@2.17	1.97	2.02	3.55
Screenings	1.62@1.67	1.52@1.57	1.52	

Coke—Prices asked for coke are: Connellsville, $6.75@7; Wise County, $6.75@7; byproduct, egg and stove, $5.75@6; byproduct, nut, $5.75@6; gas house, $6.

Minneapolis—St. Paul

The coal trade in this territory is in a rather unsettled state at the present time. The continued stretch of mild weather has had the effect of causing much uneasiness in all branches, and the wide fluctuation in prices during the past

week is laid to this cause. Retailers in the Northwest are stocked to the limit; in many cases coal is piled on the bare ground, and everyone seeming to be waiting for a cold spell to come.

Some wholesalers and jobbers are getting restless and unless some winter weather comes soon it is evident that prices will not be maintained as they have been during the past two months.

Generous shipments of steam coal from Illinois have been coming in, owing to a better supply of cars at the mines; arriving just at a time when the demand is at a low ebb, these have had a tendency to make prices waver. Domestic sizes are coming through from the East on Pocahontas and Splint coals and they will be placed to a large extent as a substitute for anthracite.

The anthracite situation at the head of the Lakes remains as before and not much relief is promised. The trade in general has come to the conclusion that they are not going to receive any more hard coal and are depending on substitutes. At the docks it is reported that the tonnage of all coal unloaded is far greater for November, 1912, than for the corresponding month last year. Every effort is being made to bring all the coal possible to the docks before navigation closes.

Ogden, Utah

Conditions throughout the Intermountain territory remain about the same with probably a slight decrease in temperature. The mines, while still somewhat behind on lump shipments, have practically filled all their nut orders and are out stimulating the demand for this grade of coal. The continuous operation of the mines has supplied sufficient slack coal to the trade and there are indications of a surplus.

The mild weather during the fall has been ideal for both the operator and dealer, but now that the mines have caught up to a marked degree, some cold weather would be welcomed.

Quotations are as follows, f.o.b. mines:

	Wyoming	Utah
Lump	$2.75	$2.75
Nut	2.25	2.25
Mine-run	1.85	1.85
Slack	1.00	1.25

St. Louis, Mo.

There isn't much change in the St. Louis market. The latter part of last month it broke for a day or two, but it is about normal again, with no indications that it will get any better until after the holidays. The only thing startling about the situation this week is that anthracite has been coming in too fast, especially grate and egg. Orders for these sizes had been canceled long ago, coke having been substituted, so that there is anthracite under demurrage on nearly all roads entering.

There is very little demand in a domestic way, and the only thing that is keeping the market up is the steam business. The Illinois Central is running their mines about two days a week on account of a car shortage, while the Iron Mountain and 'Frisco are averaging three and four days a week.

The domestic coke market is commencing to ease up on account of the movement of anthracite.

The prevailing prices are:

Franklin County and Carterville	
6-in. lump	$1.70@1.85
3x6 egg	1.70@1.85
No. 1 nut	1.50@1.60
Screenings	0.75@0.85
Mine-run	1.20@1.30
No. 1 washed	1.90@2.00
No. 2 washed	1.50@1.60
No. 3 washed	1.25@1.35
No. 4 washed	1.10@1.15
No. 5 washed	0.65@0.75
Big Muddy	
Lump and egg	$2.25
Trenton	
Lump and egg	$2.40
Mount Olive	
6-in. lump	$1.65@1.75
3-in. lump	1.40@1.50
Staunton	
3-in. lump	1.35
Standard	
6-in. lump	$1.25@1.30
2-in. lump	1.05@1.15
Screenings	0.45@0.50
Mine-run	0.95@1.00

Portland, Ore.

Market conditions here are unchanged and values are the same as during the past several weeks. The weather is cool but not cold, and the demand for fuel is, therefore, barely normal for this time of the year. The car shortage is still causing more or less trouble to dealers, who are unable to fill orders as promptly as desirable. No reports of any coal coming here from Australia this season have been received yet, and it is understood that none will come.

Production and Transportation Statistics

Baltimore & Ohio R.R.

The following is a comparative statement of fuel movement over the B. & O. R.R. and affiliated lines for September and October, 1911-12, in short tons:

	October		September	
	1911	1912	1911	1912
Coal	2,801,933	2,902,965	2,614,201	2,784,230
Coke	338,133	433,547	341,350	386,335
Total	3,140,066	3,336,512	2,955,551	3,170,565

Connellsville Coke

The *Courier* reports production in the Connellsville region as follows:

Production	Week Ending Nov. 16	Nov. 23	Nov. 30
Connellsville	218,628	221,343	218,546
Lower Connellsville	181,990	183,309	181,564
Total	400,618	404,652	400,111
Shipments To	Cars	Cars	Cars
Pittsburgh	4,059	4,126	2,863
West of Pittsburgh	6,728	6,989	8,003
East of Region	1,010	880	998
Total	11,797	11,995	11,864

The Car Situation

For the first time in 16 weeks the fortnightly report of the American Railway Association, as made up on Nov. 21, failed to show an increase in the demand for freight cars. The net shortage in the two weeks beginning with Nov. 8 remained almost stationary, although there was a very slight indication of an easier tendency in the demand for equipment.

The following table shows the surplus and shortages of cars on 183 roads on Nov. 21:

	Surplus	Short	Net Surplus
Box	4,542	43,007	*38,465
Flat	1,577	4,794	*3,217
Coal, gond. and hopper	6,167	18,172	*12,005
Other kinds	10,077	7,502	2,575
Total	22,363	73,475	*51,112

*Shortage.

On the corresponding date last year the net surplus of idle cars was 23,110. Two years ago it was 43,066, in 1900, 12,032, and in 1908, 123,619.

Norfolk & Western Ry.

The following is a comparative statement of the coal and coke shipments over the lines of the N. & W. Ry. for the month of October of the current year, and the first 10 months of the years 1911-12, in short tons:

Destination	October	Ten Months 1911	1912
Coal			
Tidewater, foreign	80,812	806,893	1,175,341
Tidewater, coastwise	316,891	2,486,951	3,085,591
Domestic	1,542,069	12,506,216	14,787,932
Coke			
Tidewater, foreign	.....	61,665	52,762
Domestic	131,007	1,199,646	1,145,181
Total	2,070,779	17,061,371	20,246,807

Foreign Markets

Great Britain

Nov. 22—Chartering is active, and with tonnage in plentiful supply at the various docks, strong conditions are in evidence in all branches of the steam-coal trade. For next months loading, such quotations as can be obtained are 6c. to 12c. above the level of current business. Prices are approximately as follows:

Best Welsh steams	$4.14@4.20
Best seconds	4.02
Seconds	3.90
Best dry coals	4.08
Best Monmouthshires	3.78
Seconds	3.66
Best Cardiff smals	2.64@2.70
Seconds	2.58

The prices for Cardiff coals are f.o.b. Cardiff, Penarth, or Barry, while those for Monmouthshire descriptions are f.o.b. Newport; both exclusive of wharfage, and for cash in thirty days, less 2½%.

Austria

The following is a comparative statement of the coal production in Austria for the first nine months of this year and last:

	1911	1912
Coal	10,775,397	11,656,476
Briquettes	105,397	120,855
Coke	1,543,801	1,716,143
Lignite	18,710,953	19,490,252
Lignite Briquettes	148,982	175,253

Belgium

The following is a comparative statement of fuel imports and exports in Belgium for the first nine months of the years 1911-12, in tons:

	Imports 1912	1911	Exports 1912	1911
Coal	5,954,300	5,419,700	3,741,000	3,899,300
Coke	691,900	489,000	728,500	755,800
Briquettes	334,700	282,000	482,600	377,000

Financial Department

Annual Reports, Notes and Comments on the Various Coal Securities

The Reading Co.

The following is a summary of the annual report of this company for the fiscal year ended June 30, 1912, issued under date of Oct. 14, 1912:

The gross receipts of the Railway Company decreased $92,239.02. The operating expenses increased $841,036.00.

The gross receipts of the Coal & Iron Company increased $1,343,522.34 during the past fiscal year as compared with the previous fiscal year and the expenses increased $639,928.35, a net increase of $703,593.99.

The gross receipts of Reading Company decreased $592,778.76. There was an increase of $705,788.84 in fixed charges and taxes, showing a decrease in surplus as compared with the previous fiscal year of $1,306,811.35.

The increase in the fixed charges and taxes of Reading Company resulted, with respect to the fixed charges, almost entirely from the fact that General Mortgage bonds of Reading Company were issued on June 1, 1911 to take up the Consolidated Mortgage bonds of the old Philadelphia & Reading Railroad Co. which matured on that date. The interest upon the Consolidated Mortgage bonds had previously been paid by the Philadelphia & Reading Ry Co. and, consequently, the fixed charges of the Philadelphia & Reading Railway Company during the past fiscal year were reduced by the amount of that interest, and the fixed charges of Reading Company were increased by the amount of the interest upon the General Mortgage bonds that were issued to take up the Consolidated Mortgage bonds.

The total surplus for the year was $32,834,300.90, an increase of $547,211.73 over the year previous. On this surplus the directors took the following action:

On the First Preferred Stock a quarterly dividend of one per cent was declared, payable Sept. 12, 1912, and the sum of $840,000 was set apart to make provision for further quarterly dividends upon that stock as follows: One per cent. payable Dec. 12, 1912; one per cent. payable March 13,1913; one per cent. payable June12, 1913.

As to the Second Preferred stock, a quarterly dividend of one per cent.was declared, payable July 11, 1912, and the sum of $1,260,000 was set apart to make provision for the following additional quarterly dividends upon that stock: One per cent. payable Oct. 10, 1912; one per cent. payable Jan. 9, 1913; one per cent. payable Apr. 10, 1913.

On the Common Stock, a quarterly dividend of one and one-half per cent, was declared, payable Aug. 8, 1912.

The Consolidation Coal Co.

This company was incorporated in Maryland in 1860. In 1911 it mined 8,231,903 tons of coal, including that produced by its subsidiaries. Company owns $1,500,000 stock of the Cumberland & Pennsylvania R.R., and has guaranteed $1,000,000 of its bonds. Early in 1909 it acquired all the minority stocks of the Fairmount Coal Co. (which was later merged in January, 1911), the Summerset Coal Co., Clarksburg Fuel Co., and the Pittsburg & Fairmount Fuel Co. thus uniting under one ownership 196,754 acres of land in Maryland, West Virginia, Kentucky and Pennsylvania.

The company also owns the majority of stock of the Northwestern Fuel Co., which concern has large docks at Washburn, Green Bay and Superior, and yards at St. Paul and Minneapolis. In 1903 it took over $501,100 of the $1,000,000 stock of the Metropolitan Coal Co. (Boston). In 1910 it acquired about 100,000 acres in southeastern Kentucky, now commonly called the Elkhorn field.

In 1909 the total authorized issue was increased to $20,000,000, $6,150,000 being issued as a 60% stock dividend and $2,626,000 sold at par. On Dec. 12, 1910, stockholders voted to increase the authorized stock from $20,000,000 (of which $19,026,000 were outstanding) to $25,000,000. The $974,000 unissued old stock and the $600,000 new stock both entitled to dividends, declared after Jan. 31, 1911, and the remaining $4,400,000 new stock (used to pay for new coal lands purchased November, 1910), entitled to dividends declared after July 31, 1912, were offered stockholders at par in December, 1910.

The first and refunding mortage 5% bonds are a first lien on 196,754 acres of coal land or rights (including the 100,000 acres purchased November, 1910), and a general lien subject to about $11,000,000 prior bond on the remaining property, about 111,404 acres, and on other tangible assets, including mining plants, tugs, barges, coal cars, securities, etc., aggregating $21,469,075. Sinking funds provision is as follows: 2c. per ton mined in the first 5 years, then 3c. for 15 years, 4c. for 10 years and 5c. for the remaining 10 years. A depreciation charge of 2½c. per ton is also charged against operation.

The annual report for 1911 shows gross earnings to be $11,420,694, and the net $2,963,845. Fixed charges were $1,580,010, leaving a balance for dividends of $1,383,835. Dividends declared amounted to $1,201,513, leaving a balance surplus of $182,322.

Reading Coal & Iron Co.—During the strike period in May of this year the gross earnings of this company were only $755,242, showing a decline of $201,472, which, after expenses, left a deficit of $303,381 for the month. The same month last year showed net earnings of $40,169.

New River Coal Co.—Interests associated with the present management have taken at par the entire present issue of $600,000, two years 6% notes. With the money derived from the sales of these, the company will take care of all bills payable which, according to the testimony at the time of the receivership proceedings, amounted to about $180,000. The interest which was due on July 1, on the $2,500,000 collateral trust 5% bonds amounting to $62,500, will also be paid.

Coal Securities

The following table gives the range of various active coal securities and dividends paid during the week ending Nov. 30:

Stocks

Company	High	Low	Last
American Coal Products..	94	94	94
American Coal Prod. Pref.	111	111	111
Col. Fuel & Iron.....	36	34⅞	35⅝
Consolidation Coal of Md.	103¾	103¼	103¾
Island Creek Coal Pref...	88	87⅞	88
Lehigh Valley Coal Sales..	235	240	240
Pittsburg Coal.....	23¼	22⅞	23¼
Pittsburg Coal Pref.....	93	91¾	93
Pond Creek.....	29	26¾	27⅝
Reading.....	172¼	170¾	171⅝
Reading 1st. Pref.....	90¾	89	89⅞
Reading 2nd. Pref.....	94¼	93¾	94⅛
Virginia Iron C. & C.....	65½	65	65½

Bonds Company	Closing Bid	Asked	Weeks Range or Last Sale	
Colo. F. & I. gen. s f g 5s...	96	97	97	97
Colo. F. & I. gen. 6s....	107½	108½	107½	June '12
Col. Ind. 1st & coll. 5s. gu.	83	Sale	82½	84
Cons. Ind. Coal Me. 1st 5s.	....	84	85	June '11
Cons. Coal 1st and ref. 5s.	....	94	93	Oct. '12
Gr. Riv. Coal & C. 1st g 6s.	*94	....	102¾	Apr. '06
K. & H. C. & Co. 1st s f g 5s.	97¾	Sale	97¾	98
Pocah. Con. Coll. 1st. s f 5s.	88	Sale	88	88
St. L. Rky. Mt. & Pac. 1st 5s.	79½	82	81	Nov. '12
Tenn. Coal gen. 5s.....	101¼	102¼	101¼	101¼
Birm. Div. 1st consol. 6s.	102	103½	102½	Nov. '12
Tenn. Div. 1st g 6s.....	102	102½	102½	Oct. '12
Cah. C. M. Co. 1st g 6s.	103½	110	110	Jan. '09
Utah Fuel 1st g 5s.....	....	....	....	....
Victor Fuel 1st s f 5s.....	....	85	85½	Oct. '12
Va. I. Coal & Coke 1st g 5s.	97	97½	97½	97½

*No price Saturday; latest bid and asked.

Delaware & Hudson Co. — Regular quarterly of 2¼%, payable Dec. 20, to holders of record Nov. 27.

Delaware, Lackawanna & Western— Extra dividend of 10%, payable Dec. 20, to holders of record Dec. 9.

American Coal Products Co.—Regular quarterly on the common of 1¾%, payable Dec. 31, to holders of record Dec. 23.

Maryland-Georges Creek Coal Co.—This company is placing $600,000 (closed) first mortgage, 6 per cent. sinking fund gold bonds dated Sept. 2, 1912, and due Sept. 1, 1932, but subject to call on and after Sept. 1, 1913, at $105 and interest.

New Mexico-Colorado Coal & Mining Co.—This company was incorporated in New Mexico on July 1, 1911, as a reorganization and consolidation of the Yankee Fuel Co.; Santa Fé, Raton & Eastern R.R.; Santa Fé, Raton & Des Moines; Santa Fé, Liberal & Englewood R.R.; Raton Water Works Co., etc., and has taken over practically all of the stocks and bonds of the allied companies named.

Jefferson & Clearfield Coal & Iron Co.—The sinking fund on the 5 per cent. bond of this company issued in 1896 is 3c. for each ton of coal mined, the payment to be not less than $50,000 per annum. In July, 1910, the company filed a mortgage for $2,500,000 covering about 16,000 acres of land in Indiana County, Penn., of which $1,500,000 was issued. Earnings of the company for the year ending June 30, 1912, were: Gross, $2,126,023; net, $333,970; interest on taxes, etc., $286,021; preferred dividends, $75,000; balance, $27,051.